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ALTOGETHER INTOLERABLE.

It is altogether and utterly intolerable that day after day and week after week should have gone by without any authentic news arriving of the course of events at the city of Pekin. That centre of Chinese "civilization" is not many miles from the coast, and even after the telegraph lines were cut, it should have been easy to get some news through that was trustworthy. Even if there were no telegraph lines, such things exist as carrier pigeons, foot messengers, semaphores and a host of other devices, and it is impossible to believe, without being thoroughly convinced of it, that none of these means were tried. If they were tried, it is equally difficult to believe that they all failed; and for this reason people are the more ready to credit the stories that have oozed through of wholesale fighting and wholesale massacre. If there were any central government in China that knows or cares whether the foreign ambassadors are alive or dead, with all their suites, it could long since have relieved the maddening anxiety of the civilized world on this subject. If no such central authority exists or prevails, it is high time the powers of Europe and America, on their own initiative, got into communication again with their representatives, or satisfied themselves as to the full nature of the calamity.

Here is one of the instances where wireless telegraphy would have been of use, granting it to be incomplete, imperfect, uncertain or anything else other than perfect. A mutilated message is infinitely better than an outraged woman, whom it may save; and if there are any other places in barbarous regions where wireless telegraphs can span intervening space and give news or warning, it is time such apparatus was put in at whatever cost. If civilization is careless of its outposts, they will soon be driven in, as now happens in China.

It is equally imperative that cable communication with China should be increased and developed. These cables may be called "strategic" at the outset, if you please, but they will soon fulfil their real mission by becoming "commercial." As it is now, news of life and death has to reach this country by going all the way around through Asia and Europe, and that will not do, even for anti-expansionists who might perchance be caught some day while touring in the land of the Yellow Terror and would fain fall back on the strong protecting arm of the United States Government.

FAN AND 'PHONE.

The lot of the business man in an American city at this season of the year is perhaps not altogether a happy one, but it might be worse. Although he cannot cool his head in the clouds of the mountain or bathe his feet in the rolling surf, he has mitigations of the toil at his city desk that were not dreamed of by his fathers. He has, chief among his modern blessings, the fan motor and the telephone, so that the smallest hole of an office can be made as breezy as the Shinnecock Hills, and the cheapest clerk has at command means of instantaneous communication with myriads of people, that the richest millionaire would not venture to duplicate for his own personal service, because it would be too costly.

In a sense, the fan motor and the telephone are antagonistic. The overworked man of business can get out of town and be in touch with his office all the time, thanks to the telephone, so that personal pres-

ence is less necessary to-day than it ever was. While this is the fact, it is also evident that under the cooling air of his fan motor, the banker or merchant can stand the stress of "record" days in the city with equanimity and comfort, and need not exile himself from town so far or so long.

The most curious part of it all is that many shrewd business men still allow themselves to go through the summer without a fan motor and with a minimum of telephone service. Large as is the yearly output of fan motors, it is still far short of the possibilities within reasonable fulfillment, while as to the use of the telephone, the education of the public is still far from complete. Many a man when asked why he did not telephone, still replies that it did not occur to him; and the habit of long-distance telephony has yet to be formed by the great majority of American men of affairs. Exceptionally hot weather, such as has been endured all over this continent the past week, has its compensations in teaching the lesson that one can keep cool without seeking sands swept by ocean breezes, and that it is quicker—as well as more pleasant—to telephone than to travel.

A NEW AMUSEMENT.

Any one who visits the summer out-of-town resorts can see at once that society has a most popular new amusement in operating automobiles. The machines dart hither and thither at all hours of the day, and are used for social calls, to meet friends at the railway station, for trips to the golf links, and for a variety of functions which go to fill up the long day. In all of this, it is noticeable that they are largely handled by the owners, particularly if they are electric automobiles, and that women are the drivers in a great many cases. Last season, in America, this state of affairs did not exist, and it may be wondered just how many seasons it will be before in the ordinary use of buggies, runabouts, etc., the every-day, ordinary coachman is allowed to do his own work. The man or woman in society who a few seasons ago thought bicycling was the correct thing, and then turned to the curious form of pedestrianism known as golf, now thinks that the only fit and proper diversion is automobilism. It cannot last as a craze or fad, but by the time the fever has worn out, those who manufacture horseless vehicles ought also to have had a good time.

There is truth in this view of automobilism as a fad, but the great fact is not to be forgotten that even should the owner by and by do less of his own driving, the vehicle will remain as a useful appurtenance to the summer home, and those who have learned its great convenience out of the city will be ready to continue their patronage of it in the city when the winter comes. It is greatly to be questioned whether we shall much longer see the annual migration of horses from town to country and back again. The automobile is changing all that very rapidly. On the other hand, it seems likely that the general desire to use electric automobiles out of the city and away from wonted sources of current supply will do much to stimulate the tendency to put in isolated or group electric lighting plants at places that hitherto have deemed such luxuries beyond their reach. With lighting to be done, motors to be run, launches to be charged and automobiles to be kept in operation, the modest isolated plant has yet its biggest work to do. The individual plants may not be large, but there will be "millions" of them.

In this connection it may be noted that the Automobile Club of America, which has already done so much to familiarize the public of fashion and wealth with the automobile, is to give an exhibition in Madison Square Garden next November, and has already disposed of all the floor space. Many forms of contest will be illustrated on a circular track, with amateur drivers, and there is no reason why the exhibition should not vie in success with the popular Horse Show.

THE CENTRAL LONDON.

We have no doubt that to a large number of our readers the article now appearing in these pages on the new Central London underground electric railway and its equipment will be of unusual interest. In New York, particularly, there are lessons to be learned from its operation, as work has already begun here on a road of the same character, while other American cities in due time will also adopt similar methods for a portion of their necessary transportation; such at least, seems to be the tendency, after travel has reached a certain volume and rate of speed. It is obvious that for express service, choice lies only between elevated and underground roads, and New York needs very badly a rapid express service such as the elevated system has been unable to afford for a variety of reasons, under the conditions hitherto existing. That the elevated can give much better results with electricity is more than likely; it is one of the bright certainties of the near future. But when we consider the New York of five or ten years hence, the underground comes again into the problem as one of the best elements for its solution.

There are many points to be noted in connection with the new London road. It is estimated that the road, built at a present cost of about $15,000,000, will carry some 50,000,000 passengers a year, or 31 per train mile. One portion of the old steam underground carries about 100,000,000 per year, or 53 per train mile, and the other 56,000,000 per year, or about 41 per train mile; and the superiority of the new line operated electrically is obvious to any one who tries it, as we have ourselves had the pleasure of doing. As a matter of fact, however, the underground roads of London have taken only 19 per cent of the total traffic, as against 81 per cent for the street surface methods. But in view of the fact that the population of London travels only 124 times a year, as compared with that of New York, which travels 210 times, it would appear that the newer methods in London have a good margin to work upon which the old methods, now at their extreme of application, have never touched. It is already stated that the new road is stimulating growth and travel remarkably in the desirable part of London through which it runs.

In adopting a system of generation and distribution for the road, several plans came under consideration, and at an early stage the continuous-current, three-wire, 500-volt method, so familiar in existing work, was dismissed as involving many difficulties, even had the third rail in one tunnel been made + 500 volts and that in the other — 500 to bring down the cost of copper. In adopting polyphase transmission, it was next decided not to deliver such current to the motors. Polyphase motors could be built to give the rapid acceleration required, but during the accelerating period they would operate under much less economical conditions than continuous-current motors with series-parallel controllers. Hence, where current is cut off only a fraction of a minute after attaining full speed, as in this instance, and where the motors have to accelerate from rest every two minutes, the polyphase motor was held by the consulting engineers to be not well adapted to the purpose. The result is that, as will be noted from the article, the system adopted is that of polyphase transmission at high tension—5000 volts—to sub-stations, where the current is transformed by static transformers to low-tension polyphase, and by rotary converters into 550-volt continuous current for the use of the locomotives. It will be further observed that the system is that of trains hauled by locomotives instead of individual cars each carrying its equipment of motors or with one trailer, as in the ordinary

street-car service. This point has no doubt been well weighed by the engineers; but it seems to us that with only one class of passenger car to be dealt with, the road might have got along very well with a plain motor-car system, instead of employing locomotives. Each regular train consists of a locomotive and seven cars, to carry 336 passengers seated. We can only hope that such a service will be fully needed every minute of the day, but we doubt it very much. It does not seem necessary to operate a "rush-hour" schedule all day long. That is where so many steam systems are expensive and weak.

One gratifying feature about the Central London is the extent to which American apparatus has been employed upon it. The list includes broadly: generators, etc.; engines, boilers, condensers, coal conveyors, cooling towers, blowers and the whole electric elevator service, as well as a number of details to which an American origin might be fairly attributed. That Englishmen have been so ready and willing to employ our machinery is one more proof of their wonted common sense and liberality of spirit. They have gone into the open market and bought what was cheapest and best, availing themselves of the world's store of knowledge and experience in these matters, without prejudice against individual or apparatus. Under such circumstances, Londoners are to be both envied and congratulated on this latest admirable addition to their means of transportation.

IONS IN GASES.

An interesting paper on this subject was recently read by M. Langevin before the Société Internationale des Électriciens, in Paris, summarizing the facts which have been most recently determined concerning gaseous ions. The ionized gaseous state of a substance seems to rank in importance with those states of matter which are already generally recognized; namely, the solid, liquid, gaseous and ultra-gaseous. It would certainly appear that the properties of gas in the ionized state are sufficiently distinctive to warrant special consideration.

A gas is said to be ionized when, instead of being in neutral electric condition, it possesses positive and negative free charges within its volume. A gas may be ionized in any one of three ways. First, by contact with a highly-heated incandescent body, as, for example, when the residual gas within the globe of an incandescent lamp becomes ionized by contact with the surface of the powerfully-glowing filament. Second, by subjection to an intense electrostatic stress, as in the case of air or other gas at the extremity of a pointed rod connected to a frictional machine, Ruhmkorf coil, or other electric source of high pressure; and, third, by subjecting the gas to the influence of ultra-violet light, Röntgen rays or the rays emitted by uranium, radium and thorium. In the last case the molecules are agitated into ionization by the impact of minute ether waves. Except in regard to the intensity of the effects produced, it does not seem that any difference is discernible in the character of ionization produced by any of these three different methods. M. Lenard has also recently shown that the ultra-violet light emitted by an electric spark discharge ionizes the air in the immediate neighborhood of the discharger.

An ionized gas possesses two remarkable properties. The first is the capacity to discharge electrified bodies, and the second is the formation of nuclei of condensation in air containing water-vapor. The power of discharging electrified bodies appears to be of essentially the same nature as that possessed by ionized liquids in electrolytic solutions. In these solutions we have a difference of potential maintained between the two immersed electrodes, and the ions move with their charges through the liquid and deliver up those charges at the electrodes, thereby discharging them. The continuation of this process constitutes the electric current of electrolysis. Similarly, a difference of potential maintained between two plates immersed in ionized air sets the ions moving in such a manner that these deliver up their charges to the electrodes and discharge the plates.

The property of cloud formation is, however, distinctively a gaseous one. It is known that a sudden expansion of air saturated with water-vapor chills the air and tends to make it deposit some of the moisture. The process of precipitation appears to be greatly favored by dust particles, which form nuclei, upon which the supersaturated water-vapor may deposit, in the form of incipient rain drops. In the absence of dust there seems to be great difficulty in forming rain drops, and dust-free air may become considerably supersaturated before it will condense its superabundant moisture. From Wilson's observations it would seem that dust-free air saturated with water-vapor must be expanded suddenly 35 per cent in volume before it will condense its moisture into rain. If, however, the air is ionized by ultra-violet light, Röntgen rays, etc., the ions form nuclei upon which the condensation takes place, and a considerably reduced expansion will effect condensation into droplets. It seems that the negative ions are more active than positive ions as nuclei, and it has been suggested that this may account for some of the phenomena of atmospheric electricity. Assuming that the air in the upper regions of the atmosphere may become ionized by the ultra-violet light arriving from the sun, the rain drops would tend to form in greater numbers around the negative ions and the descent of this negatively-charged rain would produce negative electrification of the ground and leave a positive electrification in the upper atmospheric regions.

The relatively superior condensing power of the negative ions seems to be but one aspect of a marked dissymmetry characterizing the positive and negative ions. Negative ions move faster and display greater activity than positive ions, although the charge which they carry is numerically equal to the charge of a positive ion. From a great variety of observations it seems that the charge which a gaseous ion carries is the same as the charge which an ion of liquid carries in electrolytic solutions; namely, about 2×10^{-10} coulomb, and this seems to be a natural unit of electric charge. It is apparently always the same and may be carried by an ion of any substance —liquid or gaseous. The masses which carry this ionic charge are, however, different. The negative ion carriers seem to be little masses much smaller than chemical atoms and have been named corpuscles. Thus, when an atom of hydrogen is subjected to ionization, it is supposed that a chip or corpuscle, representing about the one-thousandth part of the atom, goes off with the negative charge, while the remainder of the atom, or 999-1000 of it, carries the positive charge; the two charges are equal in magnitude, or about 2×10^{-10} coulomb, but the masses carrying the charges differ about a thousandfold. So far as is known, a corpuscle of hydrogen is indistinguishable from the corpuscle of any other substance; or, in other words, all corpuscles appear to be alike.

The importance of this subject is apparent when we reflect that the success of high-pressure alternating current transmission, that is to say, transmission at pressures between aerial conductors of 60 kilovolts and over, depends upon the non-ionization of the air. If the air is ionized by the electrostatic stress developed between the conductors, an actual current flows from the conductors into the air with a corresponding loss of energy and waste. So long as the air remains non-ionized, it retains its usually high insulation unless the conditions are such as to actually bring about disruptive discharge.

Fire in the Lachine Rapids Plant.

A bad fire, which might well have been much more serious, occurred on June 30 at the sub-station of the Lachine Rapids Hydraulic & Land Company, Ltd., Montreal. The details have now reached us in regard to it. The fire started at about 9 o'clock in the switchboard room, and though the original cause is somewhat obscure, it was probably an accident due to some men who were working on the switchboard at the time. It spread in an incredibly short space of time, arcs being formed from switch to switch in the temporary feeder panels (2000 volts), and finally jumping across some eight feet to the receiving 4000-volt board. Immediately after, the whole building was ablaze, and it was at great risk that the general superintendent, Mr. R. S. Kelsch, rushed through the flames and up the stairs to the private telephone in the upper floor, which was the only way to communicate with the power house, to request it to shut off the power. When this was done, fighting the fire was made easier, and it was completely out shortly after, as the building is fairly fireproof. Before this had been done, however, the night watchman had lost his life by suffocation, as he apparently lost his head, and did not succeed in reaching a place of safety, or one where the firemen could reach him. Customers were all left in darkness, but exactly twenty-four hours later the company had everything in shape and all users supplied. It meant almost superhuman exertions, but it proved great resource and energy among the employees of the company.

Special Cable Facilities to China.

Owing to the intense anxiety and interest aroused by the situation of affairs in China, an attempt has been on foot for some days past to arrange between the Powers now operating in China for an international cable connecting the base of Chinese operations either with Shanghai, Port Arthur, Yokohama, or some other point through which more speedy communication can be had with the outside world.

The U. S. State, War and Navy Departments have all been parties to the conference, which has been conducted with a great deal of diplomatic secrecy. Both the War and Navy Departments have been figuring for months past on a trans-Pacific cable, the work being in charge of Capt. G. O. Squier, and consequently have all the necessary information at their fingers' ends. The War Department now has 50 miles of cable ready to ship to Manila, to be followed by 400 miles more about Aug. 1. This was to be used for inter-island communication in the Philippines, but the urgency of the case may cause it to be diverted to China.

No point has yet been decided on for either end of this international line, Che-Foo and Taku both having been discussed for the Chinese terminus. It is 600 miles by water from Taku to Shanghai, the terminus of the British cable. It is less than 100 miles from Taku to Port Arthur, but the Russian land lines, both in Korea and Manchuria, have been subject to such serious interruption as to almost bar the consideration of this route for the international connecting link.

The expense of this undertaking, according to the present tentative arrangements, will be borne jointly by the Powers interested. It is impossible at present to give a fair estimate of the time that would be consumed in carrying out the project, but it is probable that the United States is in a position to do the work more quickly than any other nation.

New Illuminating Gas.

A new illuminant and heat producer has just been introduced upon the Ottawa market. The gas is manufactured by a plant simple in device, and ordinary air furnishes the chief source of supply. A motor is arranged which revolves a wheel operating a fan, which in turn drives a constant current of air through a pipe connected with an acid chamber. The air passing through this chamber is freed of its carbon and is then passed over carburetors. The latter consist of a series of tubes bearing wicks, which are kept saturated with a fluid supplied by a near-by generator. The air, thus odorized with this liquid, passes into a gasometer, from which it is supplied to the lights much as is ordinary gas. As the gas passes off to the lights, the gasometer, which is suspended in a jacket containing water, then descends, but when it reaches a certain point connection is made with the motor, which is thus put in operation, producing a current of air which, after treatment, passes into the gasometer, causing it to fill and rise again. The inventor of this illuminant claims for it a score of advantages over others. It is cheap, the cost for a 50-cp light being only a quarter of a cent per hour. The gas is said to be 93 per cent atmosphere, is non-poisonous, non-explosive and odorless; manufactured by a plant of simple construction, easy and clean to manage, which, being automatic, only requires little attention. Capt Foxell, of Philadelphia, is introducing the illuminant.

How to Run Cars.

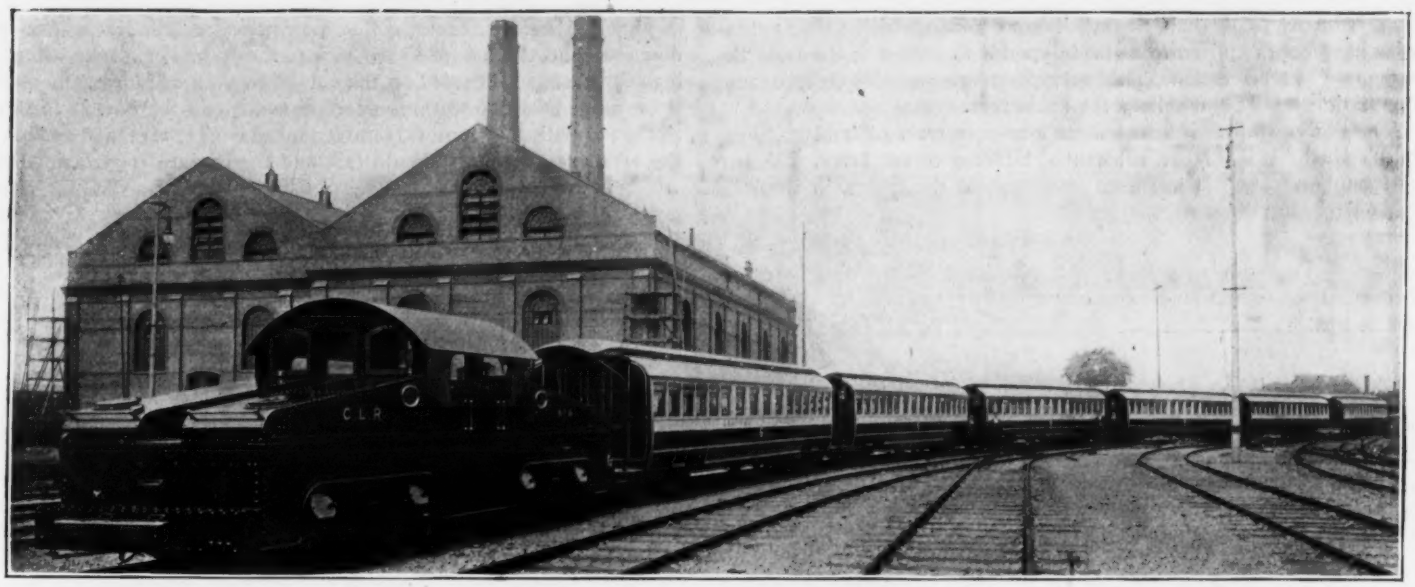
J. M. Roach, president of the Union Traction Company, of Chicago, who was himself once a street car conductor, believes that a street railroad should be run for the accommodation of the public, and that in this policy there is more profit than in any other. Not alone should the public be well served as to frequency and certainty of service, but also in the courtesy of the railroad's employees. On the latter point he has addressed a circular to the conductors and motormen, in which they are told that "elderly persons and women with children should have assistance when getting on or off your car"; and are warned not to start the car before the passengers are safely on or off. There are other suggestions, such as: "Don't run by passengers without good reason for doing so. The use of a little judgment in this will save much unfavorable criticism. Remember you are on the street to accommodate the public and not simply to run a car from one end of the line to the other. When a passenger asks for a transfer and is entitled to one he should receive it without question or display of temper on the part of the conductor, even though he had been offered one before and had refused it. Transfer rules differ in different cities, and strangers to the regulations here should be cared for properly. Look to the comfort of your passengers; keep the seats and floor of your car clean, and adjust the curtains or windows so as to offer protection from sun, rain, or cold winds. Look out for the passengers on your car on rough tracks, when passing vehicles, crossing bridges, and viaducts, and places where there are obstructions." The instructions are accompanied with an announcement of an increase of from 10 to 15 per cent in wages.

Pacific Cables.

It is stated in a recent despatch that Victoria and New South Wales have broken away from any further negotiations with the Eastern Telegraph Extension Company relative to its proposal for laying a cable between Australia and South Africa, and have thus given their adhesion to the plan for an all-British cable across the Pacific and through Canada. They have cabled to the Imperial Government asking it to begin the laying of the Pacific cable with the least possible delay. The contributing colonies to the Pacific route are New Zealand, Queensland, New South Wales and Victoria, and the three colonies which have bound themselves to the South African cable are Tasmania, South Australia and Western Australia. The selection of the Pacific route by the four principal colonies relieves all further doubt as to its immediate construction, and when laid the cable will prove of immense convenience and benefit to business men in the United States having relations with these colonies. It is also contemplated to lay a government-controlled cable between New Zealand and Australia, so that the whole of the colonies will be independent of the Eastern Extension Company in their means of communication with the outside world.

Modified City Ownership.

The Railway Commission of the Chicago Council has declared in favor of a modified form of municipal ownerchip of street railway properties, and a form of compulsory arbitration in labor disputes, which would make street railway strikes impossible. The commission agreed that street railway strikes are such an interference with public business that the municipality is justified in taking steps to prevent them. The report suggests that all grants of franchises should have a clause providing for compulsory arbitration, and that municipal ownership obtain so far as the trackage and other parts of a street railway plant actually in and a part of the street are concerned. It does not favor municipal ownership of rolling stock, power houses, and other parts of the plants, and does not even discuss municipal operation of lines.



The Central London Underground Railway—I.

INTRODUCTORY.

ONE of the most important and interesting urban railway enterprises of recent years is that of the Central London Railway, whose opening by the Prince of Wales was described in these pages last week. The road has attracted American attention for many reasons, one of the chief being the fact that much of the apparatus has been made in this country. Another reason is that Americans have been prominently engaged throughout the work in various consulting, supervisory or operative capacities. A third notable reason for the interest felt here is that the road at such a deep level is a prototype in many respects of what will be attempted in New York City in the new underground system upon which excavation has already begun. Our readers will find herewith a succinct account of the enterprise which has been carried out in a most costly and substantial manner, not less than $15,000,000 being represented in the investment.

The Central London Railway starts from the Bank of England and runs almost due west for a distance of 5¾ miles to Shepherd's Bush. The tunnels are built on the Greathead system, and, except at some of the passenger stations, separate tunnels of a diameter of 11½ ft. are devoted to the down and up trains. A map is given of the route, and the gradients are indicated in another cut, from which it will be seen that the train, on leaving each station, enters upon a down grade of 3 per cent, which immensely contributes to quick accelera-

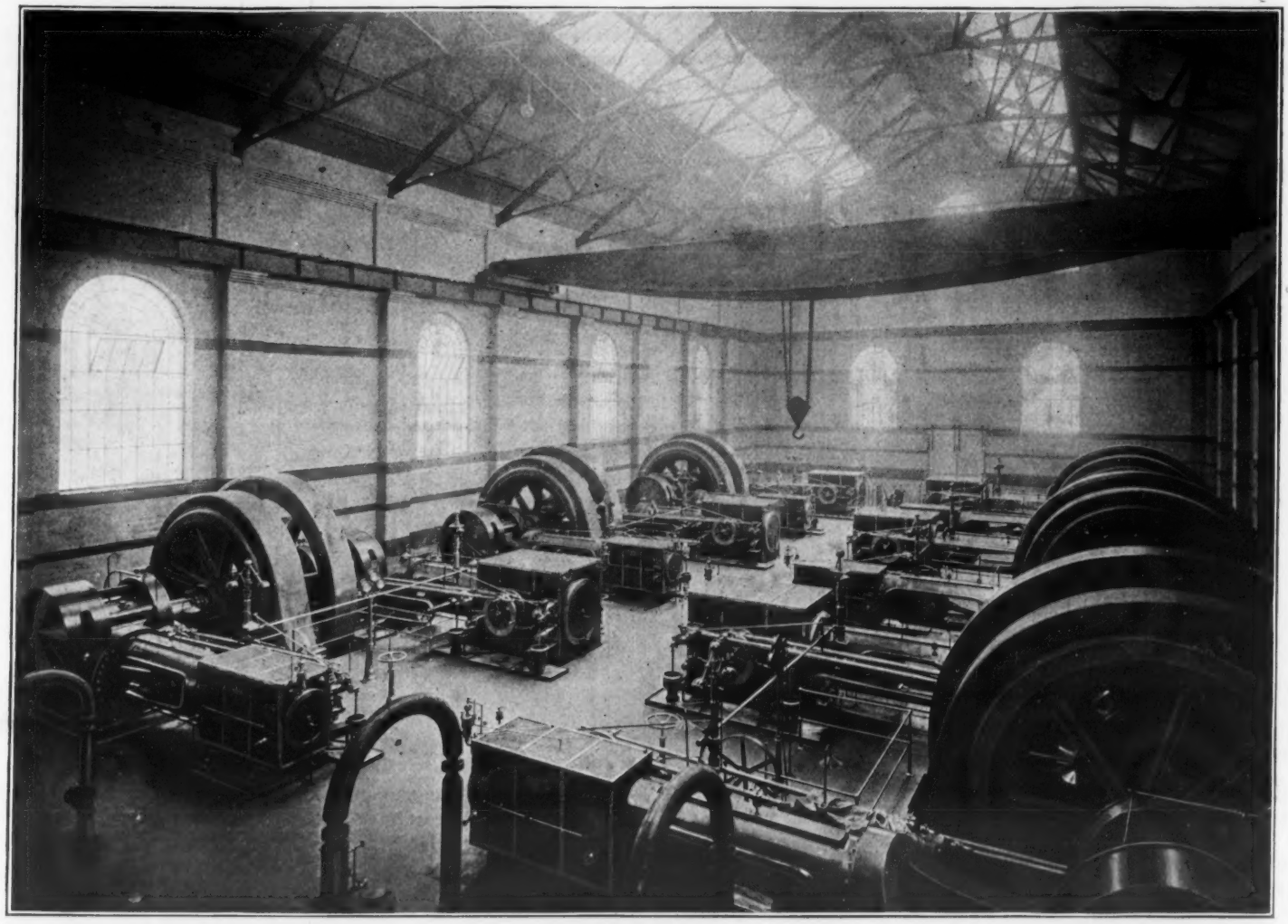


FIG. 1.—DYNAMO ROOM, CENTRAL LONDON UNDERGROUND RAILWAY.

tion, reducing to one-half the maximum demand which would otherwise have been required to be made upon it to impart to the train the same rate of acceleration. The corresponding up-grades on approaching stations assist and relieve the air-brakes.

The power station is situated on a 20-acre tract of land at Shepherd's Bush. It is a large, substantial building of red brick, with two tall smokestacks. It is shown, with one of the trains, in the head cut on the preceding page.

ENGINE ROOM.

The engine room is 200 ft. by 88 ft. and 60 ft. high, with a basement between the engine foundations of 10 ft. It is spanned by a traverser

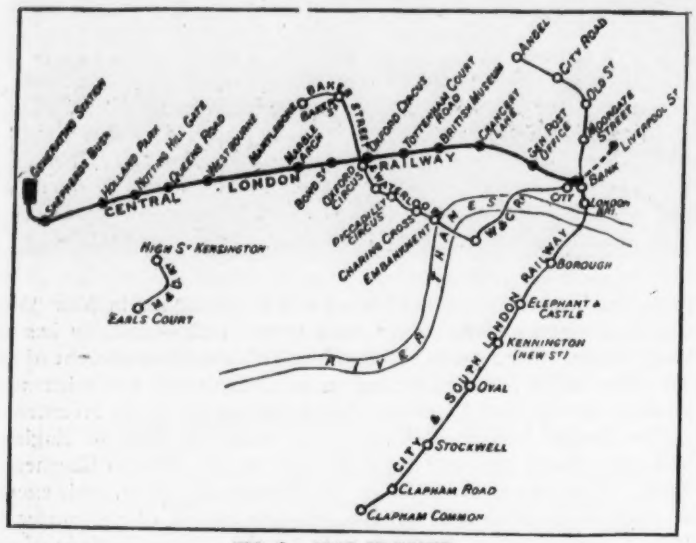


FIG. 2.—MAP OF ROUTE.

capable of lifting 30 tons, and worked by hand. There are six main engines, arranged three each side of the room, as seen in Figs. 4 and 6, while at one end are arranged four direct-coupled Thomson-Houston 50-kw exciter sets, and two 50-kw Thomson-Houston multipolar generators, direct coupled to Belliss engines, for lighting the station and offices. At this, the north end, are also situated, but on a level about 5 ft. below that of the main engine floor, the feed-water pumps and oil filters, which have already been described; an auxiliary condensing plant and the engines which drive the cooling tower fans.

The switchboard is also at this end on a raised gallery, from whence the whole engine room can be plainly seen. The basement between the engine foundation is devoted to the condensers and the piping, the engine floor being constructed of steel girders and concrete.

The engines, which are of the horizontal, cross-compound, condensing class, fitted with Reynolds' Corliss valve gear, were built by the E. P. Allis Company, of Milwaukee. Each engine, running at 94 r. p. m. with a steam pressure of 150 lbs. per square inch, develops 1300 to 1900 i. h. p. when condensing, the condensers giving a vacuum of about 26 ins. of mercury. The high-pressure cylinders are 24 ins. diameter, and the low pressure 46 ins., the length of stroke being 48 ins. Governing is effected on the cut-off of both cylinders, the maximum range being up to three-quarter stroke, and there is, in addition to the regulating governors, a safety speed device, arranged so that if the ordinary governors should fail, and the engines start racing, this will come into operation, and shut off the steam supply. This safety governor is set to shut steam off if a speed of 105 r. p. m. is attained, while the fly-wheel is safe at 125 r. p. m. The shaft is of hammered iron, and is 20 ins. diameter at the bearing and 22 ins. at the fly-wheel, running in Babbitt metal bearings 36 ins. long. It is elongated between bearings, the distance being 17 ft. 6 ins. from centre to centre, so as to carry, in addition to the fly-wheel, the revolving field of the 850-kw generator.

The fly-wheel, which weighs 50 tons altogether, including hub, is built up in eight segments, and is 18 ft. diameter. These segments are held together by double T-headed keys, which are let into the sides of the rim, being shrunk in and afterwards rust-jointed. Each segment is cast with one arm, and these arms are bolted into the hub. The crank pins are 8 ins. diameter, forced into disk cranks and riveted over; the connecting rods are 12 ft. long between centres, and of forged steel.

The Corliss valve gear is fitted with a nice arrangement of dash-pots, which prevent all hammer blows, and insure silent running, while the tripping pieces have large wearing surfaces, and the actual wearing pieces, made of hard steel, are easily renewable. An arrangement of valves allows live steam to be admitted to the low-pressure cylinder to start in case the engine should be on a dead centre, or either cylinder can be operated independently, if necessary. Before entering the engine, the steam passes through an Allis separator, and after passing through the high-pressure cyilnder it enters a receiver placed between the high and low cylinders, where it is dried before entering the low cylinder, by means of a multitubular re-heater supplied with live boiler steam. The cylinders and valve gear are well covered with asbestos non-conducting compound, being afterwards sheathed or lagged with thin steel plate. The working of the engines is very economical, the steam consumption when on full load being 14.3 lbs. per i. h. p.

CONDENSERS.

The main condensing plant is of the Allis jet type, there being six such condensers, or one to each engine. They are situated in the basement between the engine foundations. Each condenser can deal with 26,000 lbs. of steam per hour working normally, or 30,000 lbs. if required. The pumps are double-acting, 28 ins. diameter, with a 24-in. stroke, and these pumps draw the condensing water through a 22-in. wrought-iron pipe running down the centre of the basement, from the hot well situated beneath the cooling tower at the north end of the building, and deliver it back through two 18-in. pipes, laid one each side of the basement, to the top of the Barnard cooling towers.

The exhaust from the single steam cylinder of each set of condenser pumps is led into the receiver of the main engine, so as to secure the economy of compounding. An automatic release valve is provided for

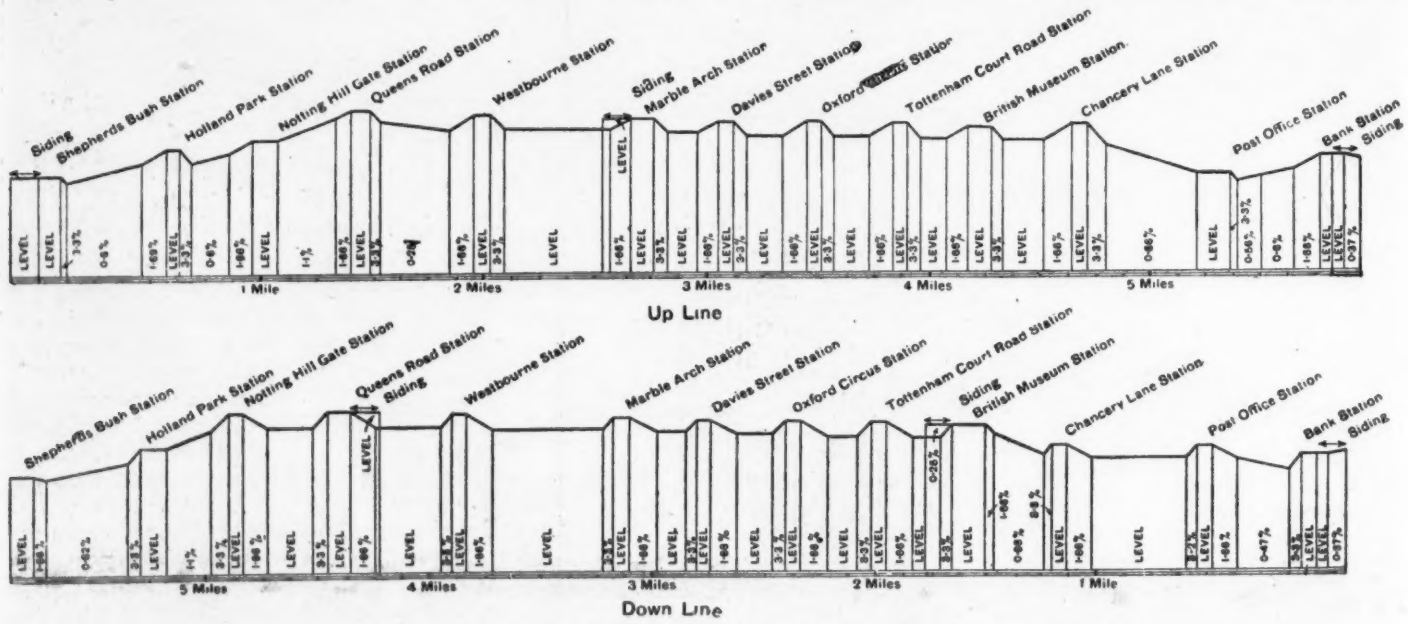


FIG. 3.—GRADIENTS ON CENTRAL LONDON UNDERGROUND RAILWAY.

each engine, so that should the vacuum fail, it exhausts to atmosphere.

There is an auxiliary condensing plant which takes the steam from the exciter and lighting sets, and also all auxiliary plant. This consists of a Wheeler surface condenser of 1900 sq. ft. cooling surface; the circulating water is drawn from the hot well beneath the cooling towers, and delivered back to the top of the cooling towers, while the air pump discharges directly into the hot well.

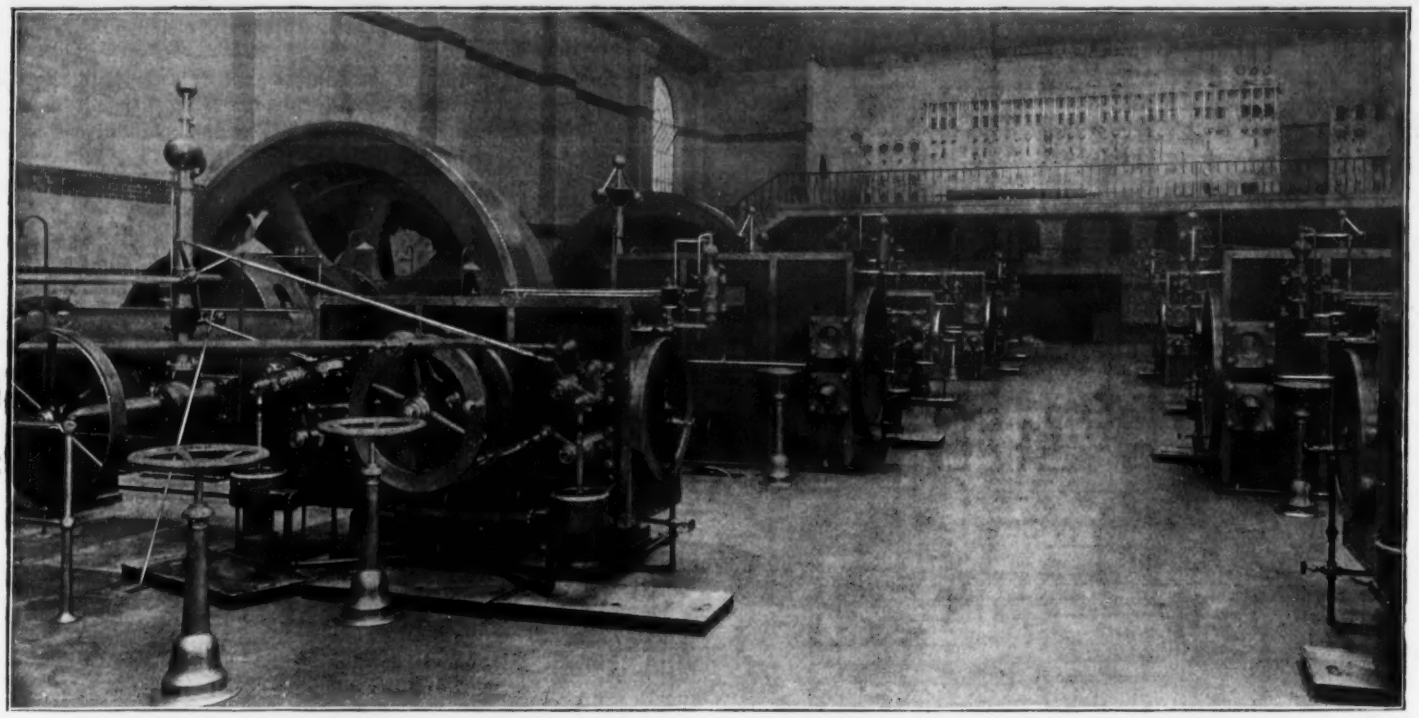


FIG. 4.—DYNAMO ROOM AND SWITCHBOARD.

THE HIGH-TENSION GENERATORS.

These are of the General Electric revolving field type, running at 94 r. p. m., and generating 3-phase alternating current at a frequency of 25 complete cycles per second, each having an output of 850 kilowatts at 5000 r. m. s. volts. The revolving field consists of 32 outwardly-projecting laminated poles and magnet cores, bolted to a cast-steel ring. This ring is carried by a heavy cast-iron spider, which in turn is mounted in the extended engine shaft, situated between the high and low-pressure cranks, and keyed firmly thereto.

The field coils are wound on formers, being afterwards slipped on to the magnet cores and insulated therefrom. They have protecting flanges of wood, and each coil consists of 79½ turns of copper strip 1.5 in. by .08 in., wound on edge. The object of the half-turn per coil is so that the terminals of each completed coil are on opposite sides of the spool, and when in position the adjacent terminals being joined together, connect up the whole winding, in series, in the best possible manner, both mechanically and electrically. The exciter voltage is 125, and the normal full-load excitation with unity power factor of 110 amperes gives a current density of 920 amperes per square inch in this winding. The diameter of the field is 143.375 ins., and the length of each pole is 9 ins., while the laminations are piled to a depth of 14½ ins., making the total area of each pole face 130 sq. in.

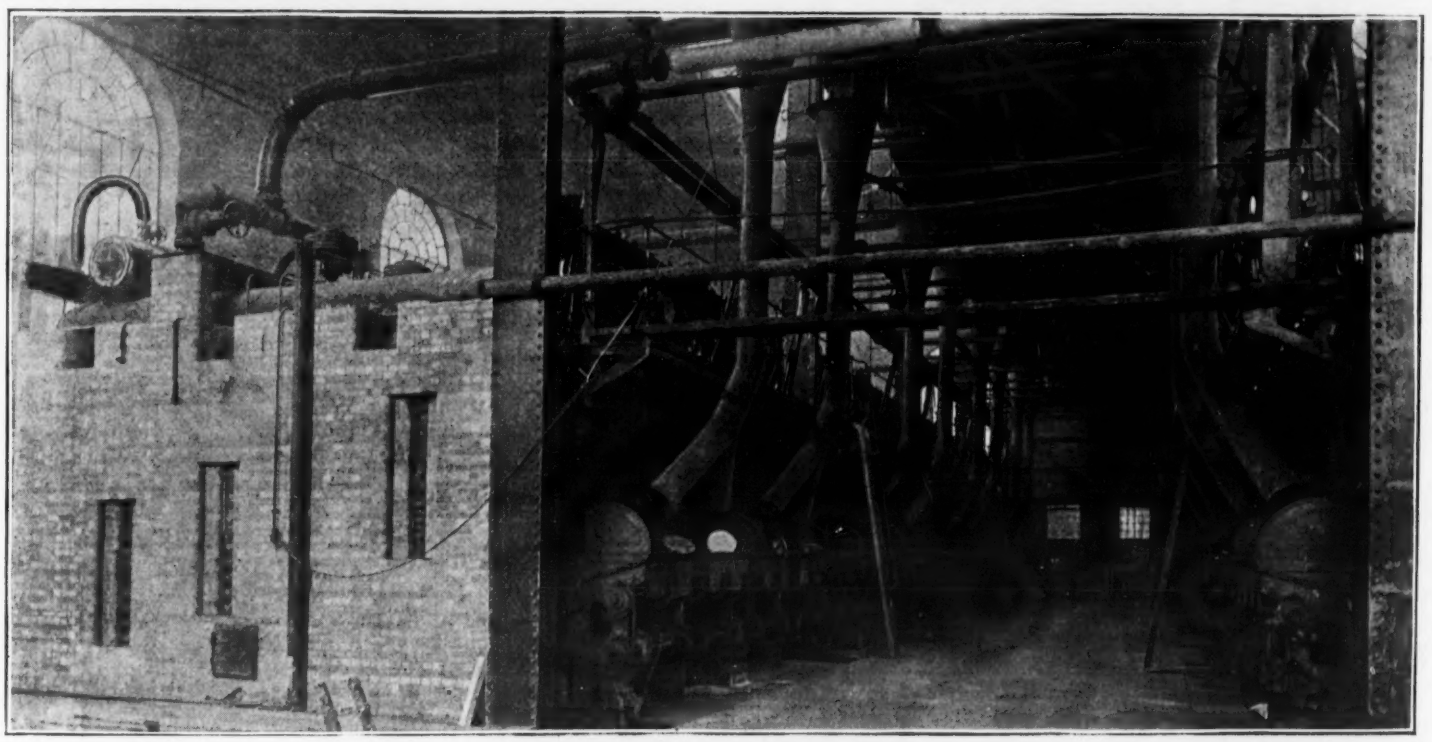


FIG. 5.—VIEW OF INTERIOR OF BOILER HOUSE.

The collectors, which merely consist of two rings to take the exciting current, are each furnished with two copper gauze brushes, and are supported on the engine shaft alongside the field spider, being insulated therefrom by ebonite. The entire weight of the revolving field, with spider, is 34,000 lbs. approximately.

The armature core, which is built up of separately-insulated sheet-iron punchings .014 in. thick, is supported by a cast-iron frame into which the laminæ are dovetailed. The actual or active length of the iron (parallel to the shaft) is 10.8 ins., and there are five ventilating ducts each one-half inch wide, spaced at equal distances apart, which, with the space taken up by the insulation between the punchings, make the total length of the armature iron (along the shaft) 14½ ins. The internal diameter of the armature is 144 ins., thus leaving an air-gap of .3125 in.

The armature is of the slotted or iron-clad type of construction; the slots, which, of course, are on the inner diameter of the armature, and of which there are 192, being 3.625 ins. deep by 1.313 ins. wide.

The winding consists of coils wound on formers, and each separately insulated, so as to allow of being readily removed in case of repairs. Each coil has 14 turns of a conductor made of 36 strands No. 17 B. W. G., the working density at full load being 1040 amperes per square inch. There are 96 such coils altogether, or 32 in series per phase, that is, 448 turns, the connection being Y. It will be noted that each coil has an entire slot devoted to it, and that the winding of each phase is also distributed into two slots per pole. This distribution of winding lessens the inductance, and consequently the reactance of the armature, and improves the thermal properties by distributing one of the chief sources of heating, namely, the C^2R losses, over a larger dissipating area, and closer to the radiating surface than is the case if the winding, and consequently the C^2R losses, be concentrated into one deep slot per pole piece.

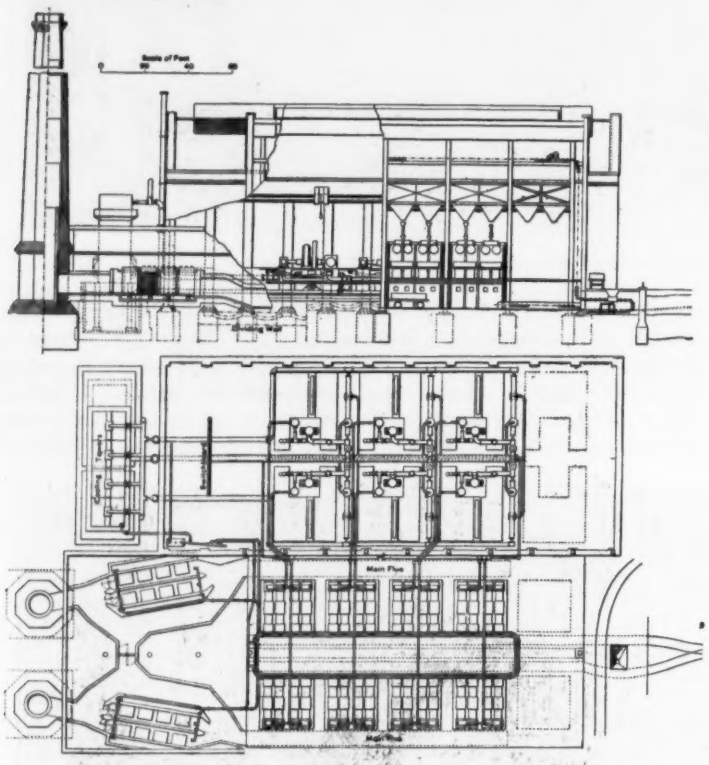


FIG. 8.—LONGITUDINAL SECTION AND PLAN OF POWER STATION.

SWITCHBOARD EQUIPMENT.

Returning to the power house, the switchboard equipment remains to be described. The face of the high-tension switchboard is shown in Fig. 4. The four small panels at the left are devoted to the four 50-kw exciter sets. These feed the exciter bus-bars through double-pole, 400-ampere switches which possess the novel feature of being made interlocking with the field switch, thus excluding the possibility of opening the field switch of any exciter while the main switch is closed. The main and field switches are double-throw.

The six large panels to the right of the exciter panels contain the controlling and measuring apparatus for the six high-tension, three-phase generators, and the two remaining large panels are devoted to the high-tension feeder cables.

At the top of each generator panel is mounted a Parshall three-phase, double-break, aluminum-bladed switch. All the measuring instruments are of the Hartmann & Braun hot-wire pattern. Of the three instruments in the upper row, the middle one is a voltmeter connected across the secondaries of a 40:1 potential transformer. There is one such transformer for each generator, and a seventh for obtaining the line voltage. The outer instruments are of exactly the same type as the voltmeter (they all take about one-quarter of an ampere at full scale reading) but are employed as ammeters by being connected in the secondaries of bus-bar transformers. These two instruments give the current in two of the three phases. The field current is also indicated by a .25 ampere hot-wire instrument, but in this case it is connected in shunt to a strip of patent resistance metal which carries the field current.

The 10-inch handwheel on the sub-base controls the field rheostat connection board, the field rheostat itself being located on iron brackets under the switchboard gallery. The field switch is of rather interesting construction. The two lower points go to the field circuit, the two upper to the exciting bus-bars, and the two intermediate contacts to the discharge resistance. In this case the discharge resistance is built for 3 ohms, and suitable to carry 40 amperes for 15 seconds without harmful rise of temperature.

The two large Hartmann & Braun illuminated dial, hot-wire voltmeters upon the swinging bracket are used respectively, the upper for indicating the line voltage, and the lower for synchronizing. There are also two synchronizing lamps above the line voltmeter. On each panel there is a red lamp constantly alight whenever the corresponding generator is excited. Upon the feeder panels there is a bus-bar transformer ammeter in each of the three phases. The sub-bases of these feeder panels each contain a Holden integrating wattmeter and a Thomson recording wattmeter.

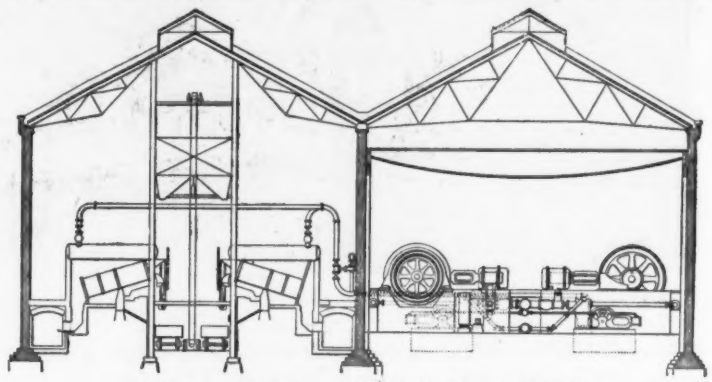


FIG. 9.—TRANSVERSE SECTION OF POWER HOUSE.

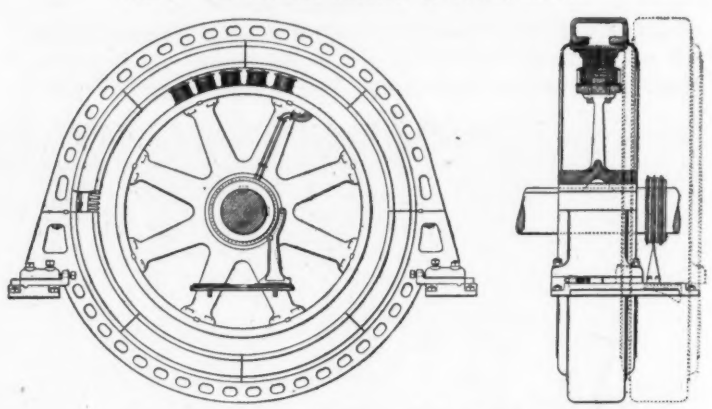


FIG. 10.—SECTIONS OF THREE-PHASE GENERATOR.

Of the four outgoing high-tension cables, two are connected to Parshall overhead type switches, and two to oil-break switches, which will be located below the gallery. These oil-break switches are of very liberal proportions. Next to the feeder panels, an additional panel will soon be installed, leading down to the power house rotary converter installation. The other panels for this additional installation will be located in another gallery on a lower level than the main switchboard gallery, and around to the east side of the building. The remaining four small panels at the extreme right hand end of the main switchboard gallery, not shown in figure, are devoted to the two lighting generators and the feeders for the lighting circuits.

THE STEAM PLANT.

The boiler house is 148 ft. by 87 ft. The rivetted steel coal bunkers, at a height of 25 ft. above the floor of the boiler house, have a capacity of 1000 tons. The coal is fed from the trucks into the buckets of a Hunt endless-chain coal conveyor. This is driven by an 8-hp continuous-current motor, located near the roof, and the conveyer is also employed for removing the ashes. In regular service, about 130 tons of coal per day will be consumed, and this is weighed on a machine in

the yard while in the railway trucks. The conveyor comprises 200 buckets, each with a capacity of 140 lbs., and when in service the buckets are loaded with about 112 lbs. each. Fifteen hundred tons of coal may be transported from the trucks into the bunkers in about ten hours. The coal descends by gravity from the bunkers through chutes to the stoker hoppers, the amount being regulated by a valve. Vicars' mechanical stokers are used, and are driven by either or both of two H. P. Bumstead & Chandler steam engines.

The boiler equipment consists of sixteen Babcock & Wilcox water-tube boilers, in eight groups of two each, there being four groups on each side of the central gangway. There is space for four more boilers. Each of these boilers contains 3580 ft. of heating surface, has a grate area of 90 sq. ft., and an evaporative power of 12,000 lbs. per hour, developing 700 nominal horse-power at a pressure of 160 lbs. per square inch. The boilers withstand a hydraulic test of 250 lbs. per square inch. The steam and water drums are 42 ins. in diameter, and 23 ft. 7 ins. long, with a cross drum 24 ins. in diameter and 90 ins. long. The boilers are supported upon independent steel stanchions in such a manner as to have perfect freedom to expand.

The waste gases may be led direct from the two main flues, one on either side of the boiler house, to either or both of the stacks, or from either flue to either stack. But normally the gates are closed, and the gases are led through the economizer gates into and through the Green's economizers, of which four sets have been provided, two sets for each bank of boilers. Each separate set of economizers is made up in four groups of 192 tubes per group. The tubes are 9 ft. by

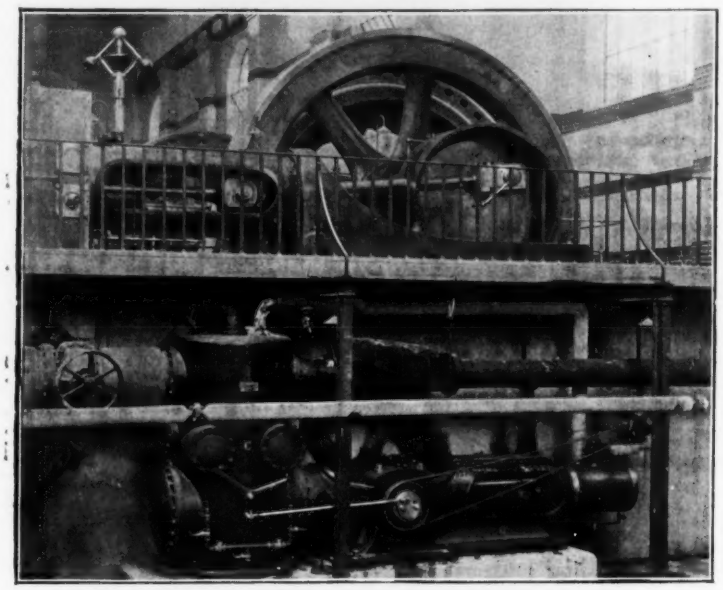


FIG. E.—GENERATING UNIT AND STEAM CONNECTIONS.

4 9-16 ins. The scrapers are driven by continuous current motors, a 5-hp motor serving for each pair of economizers.

The brick chimney stacks are 250 ft. high, and 10 ft. internal diameter at the base. They are built octagonal, with square bases. Each stack is protected by three lightning arresters. There is a large sump near the chimneys for the discharge of the water when the boilers are blown off.

WATER SUPPLY AND FEED WATER.

Water is derived from the Grand Junction Water Works Company's mains, there being two mains. After passing through a softener, the water is delivered to the cistern, or hot well, situated beneath the cooling towers, or may be pumped either directly or through either or both sets of economizers into the boilers.

The four cooling towers which are used to cool the water from the condensers are of the Barnard type, and are situated at the north end of the building. They consist of iron wire netting, suspended within a cast-iron casing. The hot water is allowed to trickle down the netting, while a strong current of air is forced into the base of each tower by means of two fans, and deflected upwards by curved baffle plates. The fans are driven by separate Belliss engines, each of 35 horse-power, running at 180 r. p. m., the four engines being situated inside the engine house.

The feed-water pumps are vertical-duplex, direct-acting, made by F. Pearn & Company. The pump rams are 8 ins. diameter, and the steam cylinders 12 ins. with a 15-in. stroke. Each has a delivery of 16,000 gallons of water per hour working against full boiler pressure.

In ordinary working, the feed water is drawn from the delivery or exhaust of the jet condensers before passing through the cooling towers, thus obtaining the greatest possible temperature. A set of Railton & Campbell oil filters is provided, through which the water is passed before being pumped directly or through the economizers to the boilers.

STEAM PIPING.

The steam piping is arranged so that each group of two boilers feeds one engine through an 8-in. pipe. All the boilers can, however, work into a common main header 12 ins. diameter, which runs at right angles to their length, and which is provided with suitable valves to cut off any desired portion. Thus it will be seen that any group of boilers, or any engine, can be cut off at will, or operated independently from the rest or each other.

All the pipes are covered with fossil meal non-conductor to a depth of 2 ins. on the high-pressure steam and one-half inch on the exhaust and smaller piping, then sewn up with canvas and painted three coats. The Crane Company, Chicago, U. S. A., supplied the large piping, while Best, Fox & Co., Pittsburg, Pa., U. S. A., undertook the smaller sizes.

Technical Education.

In a recent address delivered before the Engineering School of the University of Wisconsin, at Madison, Wis., Mr. B. A. Behrend, in sketching German methods of technical education, said that the polytechnic schools cannot turn out specialists in steam engineering, electrical engineering, bridge building, and so forth; but men who, in virtue of possessing a sound, genuine knowledge of the scientific principles underlying these various branches of engineering, are capable of becoming specialists in practical life. They ought, he said, to be fitted out, so to speak, with a store of latent knowledge which, like so much potential energy, is always ready to be turned to account. The great problem of education lies in the difficulty of combining a sound knowledge in one special branch, for instance, in engineering or medicine, with an all-round liberal education. The realization of this difficult task in the universities of the coming century, viz., the uniting of breadth of culture without superficiality, and depth and precision of knowledge without narrowness, has become the great aim of thoughtful educators in Germany; but it cannot be denied that the way to it is beset with formidable difficulties. But the majority of men need another education, an education that fits them to be good machinists, foremen and draughtsmen. They need a technical education which is simply a good education with more attention to physical and chemical science, to drawing, and to modern languages than is common. And added to this, a further training of the hand and eye by instruction in modeling and simple carpentry. Such education can be obtained in Germany in so-called "technical middle schools," in which competent teachers give a sound elementary instruction in these subjects. These schools generally take men of all ages, but are in all other respects like schools, and rank as such.

The Electric Railways of Canada.

Mr. Geo. Johnson, Ottawa, Dominion statistician, has compiled some figures about the electric railways of Canada. During the year ended on Dec. 31, 1899, the 632 miles of track were so used that the total number of miles run by cars was 26,646,847. The number of passengers carried was 104,033,659. Compared with the previous year, the number of passengers carried increased nearly 9,500,000, and the number of miles run by over a million. The amount of paid-up capital invested in electric railways in the Dominion is $21,700,000. The electric cars traveled over four million more miles than the passenger and mixed trains of the steam railways. Together, the steam and electric railways carried over 120,000,000 passengers, and the proportion was about 13 by steam to 87 by the electric railways.

Electrocution of Dogs.

Under a new law, all the stray dogs captured in Columbus are to be killed, and it has been decided to electrocute them. The city electrician is constructing a metal cage, the floor of which will be of copper, and it will be connected up so that a powerful current can be turned into it.

The Original Discovery of Magnetism.

AN ARABIAN TRADITION CONNECTING IT WITH THE HOLY STONE IN THE KAABA AT MECCA.

By Frederick Trimmer, F.R.G.S.

WHILE the history of the sailor's compass and the chronology of the application of the magnetic property to the purposes of navigation have been gone into by inquirers, and the infancy of the needle, as with some of the earlier arts, said to be traced to a Chinese source, no light comes from the same direction upon the original discovery of the magnetic property; perhaps, because inquirers have deemed the Chinese literary waters too deep for fishing in.

There is, however, another field, and one apparently overlooked, where inquiry throws some light upon the subject, and, though not found in any records that have been preserved, the Arabian tradition may be none the worse for that, since the Arabs certainly were among the earliest of navigators. If you ask the Nakhuda—Captain of any Arab dhow in the Red Sea or the Persian Gulf where the Arabs got the compass from, he will point first to the sky above, then in the direction of Mecca, and answer, in the deep, guttural tones of the tongue, Hajar u'l Aswad—the Black Stone. And if you know him well enough, and he is inclined to be communicative, which not often is the case, he will explain that the knowledge came to the Arabs through the Hajar u'l Aswad, the Holy Stone in the sacred Kaaba at Mecca—the stone which was dropped from Heaven for that purpose in Ishmael's time, and reached the earth at the very spot where the holy Kaaba stands to-day.

A Mohammedan doctor, if you should meet one later and put the same question, will tell you the same, and add many particulars. The Hajar u'l Aswad, the Holy Stone, so say the traditions of Arabia, fell to the earth in the days of Ishmael, the son of Hagar, cast out by Abraham, the patriarch, as the Jewish narrative describes. Ishmael, when he grew up, became the head of a tribe living in the Mecca valley, and the fall of the stone occurred under circumstances, leading the tribe to believe that it had come direct to them from the hand of Allah.

Ishmael, so the tradition runs, had been taken with a sudden sickness at a critical time, the tribe being pressed by powerful enemies, and all hope of their chief's recovery by human effort being given up, his people had abandoned themselves to prayer. In the midst of these proceedings there appeared a blazing meteor streaming across the sky, which fell, burying itself in the earth close by, and the same hour the chief began rapidly to mend.

The meteorite, for such it was, being afterward recovered from where it had sunk many yards in the ground, became immediately an object of the greatest reverence, being regarded as a message to the tribe from Allah's own hand to let them know their prayers were heard. This happened some 33 centuries ago, the discovery of

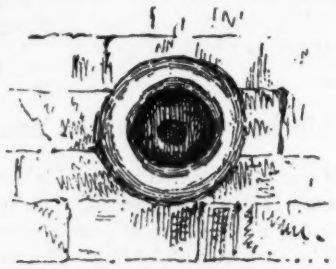


FIG. 1.—BLACK STONE.

the property of magnetism being connected with it by events of a somewhat later date, about two or three centuries afterward, as follows:

With the passage of time the stone thus dropped from the sky, instead of being forgotten, had become an object of increasing reverence, the minds of the people of the tribe having invested it with magical qualities for healing sickness, if touched, assuring fortune before a journey, and in other ways; a temple having been built for its safe keeping, upon which same site stands the Kaaba of to-day.

The affairs of the Meccan tribe being singularly prosperous, and their camels often escaping distemper when the same disease was rife among the animals of the neighboring tribes, some of these others began to connect this good fortune with the possession of the Black Stone—that being the literal translation of Hajar u'l Aswad; these thoughts taking shape at length in a determination by some younger men of the jealous neighbors to make a raid on the Temple. If the stone had magic properties, they reasoned it was worth risking one's life to get possession of it.

A dramatic account follows of the breaking into the Temple by the two chosen to carry out this purpose, which, as they well knew, would mean certain death should an alarm be given; but a few facts only need be set down here.

Effecting an entrance into the building without discovery by the watch, the robbers found to their chagrin that for safe keeping the stone had been let into a heavy block of granite, which must be overturned in order to release the prize, an undertaking almost beyond their united strength. Succeeding, however, in doing this after extraordinary efforts, and to which delay was doubtless due what followed, the thieves, hugging the coveted object, were in the act of

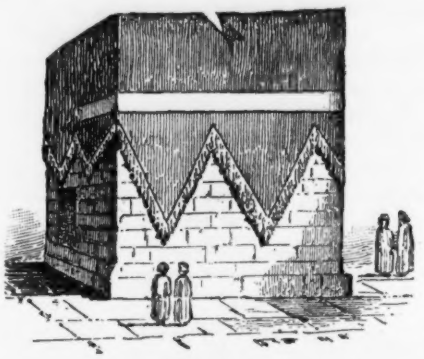


FIG. 2.—KAABA, EXTERIOR VIEW.

creeping stealthily off by the way they had climbed in at, when in some manner an alarm was raised.

Filled with rage at the disappointment, and knowing that escape was impossible, the robbers revenged themselves by dashing the stone to pieces on the Temple floor, just as the guards, knives in hand, rushed in upon them.

A closing scene, displaying some stage effects! And should electrical science ever erect a Temple of Fame, it might consider the claims of these two unnamed robbers of 30 centuries ago in the valley of Mecca, to a place. For it was, so the Arabian tradition runs, in the fitting together again of the broken pieces that the discovery of the magnetic property in the meteoric iron of the Holy Stone was made, the self-same stone showing the breaks remaining in the Kaaba an object of undiminished reverence to-day.

Scientific Education a Century Ago.

In tracing the development of scientific education, Mr. B. A Behrend, before the Engineering School of Wisconsin University, said that at the dawn of this century the universities had four departments, called Faculties, devoted to Theology, Law, Medicine and Philosophy. In the philosophic department were taught of philology the dead languages only, and of natural science only mathematics and astronomy. There was no science of physics, no science of chemistry. A speculative philosophy of nature, the inheritance of the schoolmen, overflowing with flowery rhetoric and unmeaning verbiage, was taught by Hegel and Schelling. They studied their own minds and considered the meanings of words instead of studying things and recording phenomena. Their contempt for fact and observation was their most characteristic feature. It was an acute aphorism of the time to say, "I despise you as I do a fact." These gifted teachers did not care for problems less abstruse than the origin of life and matter. They solved the great mystery of existence simply by denying this existence; they approached all problems on the "high *a priori* road" of speculation. With a sort of contempt the schoolman and philologist looked down upon the scientific investigator. The former knew everything that others had spoken and written before his time; the latter modestly owned, that—to use Newton's noble words—he had been but as a child playing on the seashore picking up here a shell and there a pebble while the great ocean of truth lies unexplored before him. Justus Liebig, the great chemist, the corypheus of German natural science, says in a striking censure of the state of chemistry in Germany in 1840, that he deplored having been "cheated out of two precious years of his life" by listening to the aimless and purposeless teachings of Schelling.

Electrostatic Discharges on a High Tension Line.

THE Telluride Power Transmission Company, the pioneer in electrical transmission work, is at present employing the very high working voltage of 40,000 on the lines of its Utah plant. The generating station of this plant is located near the town of Provo, south of Great Salt Lake, and power is transmitted in a westerly direction over two lines. One line, 35 miles in length, is of No. 5 copper, and transmits to the mining camp of Mercur. Another, of 56 miles in length, passes a little to the southwest, and finds its terminus in the

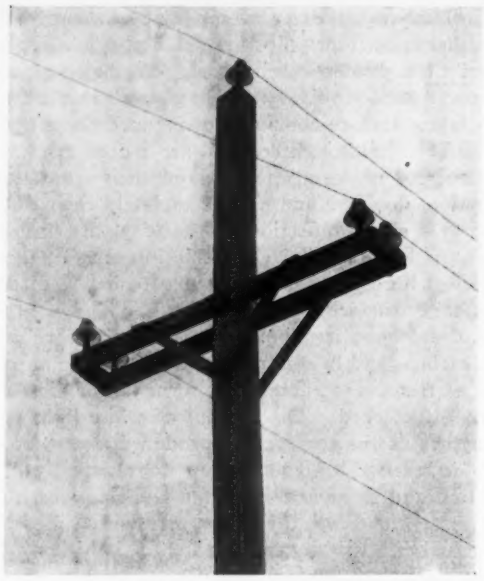


FIG. 1.—METHOD OF MOUNTING WIRES.

mining district of Tintic. This line is of aluminum, and equivalent to No. 4 copper. The third line, also of aluminum wire, and equivalent to No. 5 copper, passes along a ridge of mountains and connects the camps of Mercur and Tintic, the three lines thus forming a triangle. The last-mentioned line serves as an "equalizer," and in case one of the two lines from the generating station becomes disabled, with the other line it serves to transmit to both places. Thus the energy is at times transmitted as far as 70 miles. The total power transmitted is about 1500 kilowatts, and the normal line loss is about 4 per cent. It was to be expected that a line of this extraordinary character would involve peculiar phenomena and transmission difficulties.

The wires are mounted in the form of an equilateral triangle, as shown in Fig. 1. One wire rests on an insulator on the top of the pole and the other two are near the extremities of the cross-arm, which is 7 ft. in length. The insulators are of the special "Provo type," glass, mounted on wooden pins which have been boiled in paraffine, and the cross-arm is stayed with two wooden braces. The cross-arm itself and the wooden braces are steeped in a black insulating compound.

This power transmission line is occasionally subject to a condition which may well be called the very worst possible—the effects of what is known as a salt storm. It so happens that on the shores of the Great Salt Lake there are arid plains which at one time were undoubtedly a part of the lake bottom, and on which are now heavy deposits of fine, dry salt. Very high winds, especially in the early spring, whirl this salty dust into the air, and when it meets clouds of moisture, it becomes sticky, and adheres closely to anything with which it may come in contact—including the poles and cross-arms of the power company's lines. At such times, when the poles are pretty liberally encrusted with salt, and especially when the difficulty is aggravated by clouds of moisture, which frequently surround the line on its most elevated portions along the edge of the divide connecting Mercur and Tintic, powerful discharges occur at frequent intervals which sometimes reach the state of momentary short circuits, causing the lights to dip, and occasionally stopping or interfering with the operation of the motors. These discharges are, of course, best observed in the night time.

The discharge starts with a sparking at the insulators, often occurring on a dozen or more poles simultaneously. There seemed to be a point on the circumference of each insulator down which a series of sparks break out, which next travel along the petticoats under the insulator to the pin, and then down the pin to the cross-arm. At times, the sparks appear to exhaust themselves on reaching the cross-arm, there often being no further advance.

The sparks are crisp and blue, and snap like the discharge of a Leyden jar. They follow each other with increasing rapidity until a second point is made a nucleus for another series, then a third, and so proceeding until an almost continuous sheet of sparks follows the upper surface of the insulator, the noise at this time increasing to a roar. The supply of sparks then becomes so great that a movement toward the centre of the cross-arm is started. The convolutions on the under side of the insulator are abandoned, and the sparks seem to jump from the edge of the insulator to the pin, and move more and more toward the centre of the cross-arm, until those from the two insulators meet. The discharge then loses its sparking nature and assumes the familiar form of an electric arc, instantly rising from the cross arm and stretching from wire to wire at the points where the wire is tied to the insulators. The flame often reaches a height of from 6 to 8 ft., holding for a second or two, when it breaks from one of the wires and dies away. Fig. 2 shows a photograph of a discharge of this nature, and fully bears out the statement that the appearance is very impressive and of great beauty.

While the line appears to be thus preparing itself for a discharge, the preliminary starting sparks seem to occur at a number of poles simultaneously. It is difficult to select the pole out of a dozen at which an arc will occur, and after the arc occurs, the whole line ceases sparking for a brief period, perhaps 30 to 60 seconds, and then re-commences.

All the discharges are between the two outside wires, although the sparking effect is almost as noticeable on the top insulator as on the lower ones; but the sparks from the top wire merely creep down the pole, and are not deserved to take any part in the flame discharge. The power house instruments also indicate that a short circuit occurs between the two lower wires.

The sparking is not confined to the beclouded area, in several instances discharges being observed beyond; but these were slight compared with those occurring in the midst of the clouds. No interruption of power or lights has occurred at such times, except when the arc was actually continuous between the wires. One flash which blew the station fuses and caused a shut-down, held between the wires for 5 or 6 seconds, but most of the flashes cease almost on the instant of completing connection. A loud report is heard just at the instant

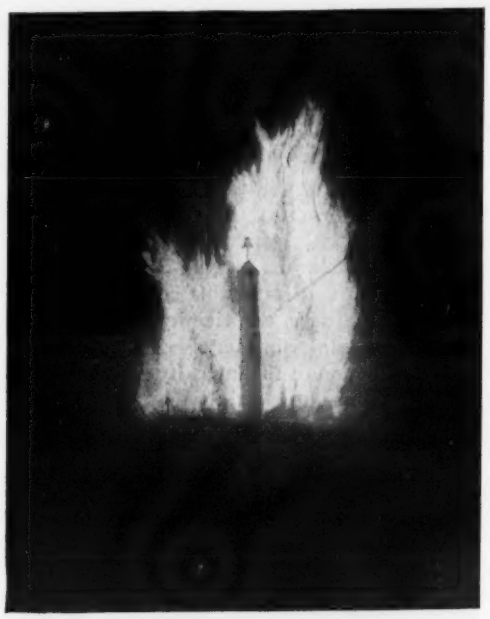


FIG. 2.—EFFECT OF SALT STORM.

A momentary arc, following progressive surface leakage, over coating of salt, between conductors 76 ins. apart, in a cloud area, at the apex of the Mercur Mountains, near the terminus of the 70-mile, 40,000-volt, 3-phase transmission of the Telluride Power Company's Utah plant.

the sparks met on the cross-arms, when the discharge assumes a flaming condition.

On one occasion, between 8:30 p. m. and midnight, there were counted about 80 discharges along a section of the line covering a distance of two miles; as the clouds moved along the line, the discharges following them, and distant flashes from over a hill could be

seen, and occasional slight sparking was later observed where the flaming discharges had been frequent.

On examination of the poles, it is found that there is no visible charring effect. The paraffine on the pins bears light brown marks, and the salt which is encrusted on the cross-arms is knocked off in zig-zag lines by the discharge. One or two blown fuses at the power house have comprised the total damage.

The conditions were apparently so severe and the damage and inconvenience have been so slight, that the experience may be considered a triumph for power transmission at these high pressures. As the result of its experience, the Telluride Power Company is now contemplating the installation of a line which will operate at 60,000 volts. It is said that power has been successfully, though experimentally, transmitted over some of the present Telluride lines at a pressure of 125,000 volts.

Elements of Illumination—VI.

BY DR. LOUIS BELL.

FROM what has been said about color reflection it is obvious enough that the loss in intensity in a reflected ray may be very considerable, even from a single regular reflection under quite favorable conditions. Many experiments have been made to find the absolute loss of intensity due to reflection. This absolute value of what is called the coefficient of reflection—that is to say, the ratio between the intensities of the incident and reflected light, varies very widely according to the condition of the reflecting surface. It also—in case the surfaces are not without selective reflection in respect to color—varies notably with the color of the incident light.

The following table gives a collection of approximate results derived from various sources. The figures show clearly enough the uncertain character of the data:

Material.	Coefficient of Reflection.
Highly polished silver	.92
Mirrors silvered on surface	.70—.85
Highly polished brass	.70—.75
Highly polished copper	.60—.70
Highly polished steel	.60
Speculum metal	.60—.80
Polished gold	.50—.55
Burnished copper	.40—.50

The losses in reflection are due to absorption and to a certain amount of diffuse reflection mixed with the regular reflection. The above figures are for light in the most intense part of the spectrum and for rather small angles of incidence. For large angles of incidence—85 degs. and more—the intensity of the reflected beam is materially diminished, owing probably both to increase in absorption and to diffuse reflection. Mirrors silvered with amalgam on the back, and various burnished metals sometimes used for reflectors, belong near the bottom of the table just given. Silver is distinctly the best reflecting surface; under very favorable circumstances the coefficient of reflection of this metal is in the vicinity of .90. A very little tarnishing of the surface results in increased absorption and diffusion, and a still further reduction of the intensity of the reflected ray. The values of these coefficients show plainly the considerable losses which may be incurred in using reflectors in connection with artificial lighting.

So far as general illumination is concerned, the light diffused at the reflecting surfaces is not altogether lost, but that absorbed is totally useless. In the case of ordinary reflecting surfaces one deals with a mixture of regular and diffused reflection, and in practical illumination the latter is generally more important than the former, for it determines the amount of light which reaches the surface to be illuminated in ways other than direct radiation from the illuminant. Obviously, if one were reading a book in a room completely lined with mirrors, the effect of the illumination upon the page would be vastly greater than that received directly from the source of light itself. On the other hand, a room painted black throughout would give very little assistance from reflection, and the illumination upon the page would be practically little greater than that received directly from the lamp. Between these limits falls the ordinary illumination in enclosed spaces. Generally speaking, there is material assistance from reflection at the bounding surfaces. The amount of such assistance depends directly upon the coefficient of diffuse reflection of the various surfaces concerned, varying with the color and texture of each.

As has been already indicated, diffuse reflection is rough, heterogeneous, regular reflection, more or less complicated, according to the texture of the reflecting surface, by multiple reflections in the surface before the ray finally escapes, and therefore, the coefficients of diffuse reflection are not so widely different from those of direct reflection as might at first sight appear probable, so far at least as the total luminous effect is concerned.

In certain kinds of diffuse reflection there is considerable loss from absorption as well as from multiple reflections. This is conspicuously the case in the light reflected from fabrics, where there is not only reflection from the surface fibres, but the rays before escaping are more than likely to have to traverse some of them. This is illustrated in a rather crude but typical way in Fig. 1, which gives a characteristic case of asymmetric reflection. We may suppose that the beam falls upon a section of fabric having a well-marked nap. In the cut *aa* is the fabric surface composed of inclined fibres or bunches of fibres. These fibres, although colored, are more or less translucent and are not colored uniformly throughout their substance. Owing to their direction, rays 1, 2 and 3 get completely clear of the surface of the fabric by a single reflection. These rays are but slightly colored, because of the comparatively feeble intensity of the coloration of the individual fibres, and have a strong tendency to reflect white light from a shiny surface. On the other hand, rays 4, 5 and 6, inclined from the other direction, are several times reflected before clearing the surface, and in emerging therefrom have to pass through the bunches of translucent fibres that form the nap. As the result they are strongly colored. The amount of white light is very small and the structure of the surface has produced a marked changeable coloration. In reality, of course, few rays actually escape on a single reflection and those striking almost in line with the direction of the fibres, as 4, 5 and 6 in the figure, may be reflected many times, so that the actual effect is an exaggeration of that illustrated. Moreover, the material of the surface fibres exercises a considerable influ-

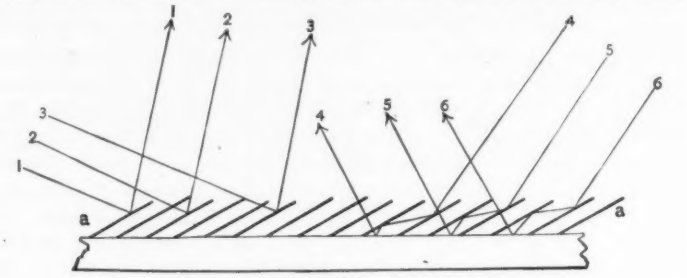


FIG. I.—ASYMMETRIC REFLECTION.

ence on the amount and character of the selective coloration. Silk is especially well adapted to show changeable color effects, since in the first place, its fibres can be made to lie more uniformly in the same direction than the fibres of any other substance, and are themselves naturally lustrous, so as to be capable even when strongly dyed of reflecting, particularly at large angles of incidence, a very considerable proportion of white light. Being lustrous they form rather good reflecting surfaces, and hence the light entangled in their meshes can undergo a good many reflections without losing so much in intensity as to dull conspicuously the resulting color effect; besides, silk takes dyes much more easily and permanently than other fibres and, hence, can be made to acquire a very fine coloration. Wool fibres take dye less readily and it is not so easy to give the surface fibres a definite direction. They are, however, quite transparent and lustrous enough to give fine rich colors. Cotton is inferior to both silk and wool in these particulars; hence, the phenomena we have been investigating are seldom marked in cotton fabrics. In velvet, which is a very closely woven cut pile fabric, the surface fibres forming the pile stand erect and very closely packed together. It is difficult, therefore, for light to undergo anything except a very complex reflection, and practically all the rays which come from the surface have penetrated into the pile and acquired a strong coloration. The white light reflected from the surface of the fibres hardly comes into play at all, so that the result is a particularly strong, rich effect from the dyes, in silk velvet at least. Cotton velvet, with its more opaque fibres, seems duller, and particularly if a little worn reflects enough light from the surface of the pile to interfere with the purity and intensity of the color. Much of the richness in effect of rough-colored fabrics and surfaces is due to the completeness of the multiple reflections on the dyed fibres, which produce an effect quite impossible to match with a smooth surface unless dyed with the most vivid pigments.

In practical illumination one seldom deals with fabrics to any considerable extent, but almost always with papered or painted surfaces. These are generally rather smooth, except in the case of certain wall papers which have a silky finish. Smooth papers and paint give a very considerable amount of surface reflection of white light, in spite of the pigments with which they may be colored. The diffusion from them is very regular, except for this surface sheen, and may be exceedingly strong. When light from the radiant point falls on such a surface it produces a very wide scattering of the rays and an object indirectly illuminated therefore receives in the aggregate a very large amount of light. A great many experiments have been tried to determine the amount of this diffuse reflection which becomes available for the illumination of a single object. The general method has been to compare the light received directly from the illuminant with that received from the same illuminant by a reflection from a diffusing surface.

The following table gives an aggregation of the results obtained by several experimenters, mostly from colored papers:

Material.	Coefficient of Diffuse Reflection.
White blotting paper	.82
White cartridge paper	.80
Ordinary foolscap	.70
Chrome yellow paper	.62
Orange paper	.50
Plane deal (clean)	.40—.50
Yellow wall paper	.40
Yellow painted wall (clean)	.40
Light pink paper	.36
Yellow cardboard	.30
Light blue cardboard	.25
Brown cardboard	.20
Plane deal (dirty)	.20
Yellow painted wall (dirty)	.20
Emerald green paper	.18
Dark brown paper	.13
Vermilion paper	.12
Blue green paper	.12
Cobalt blue	.12
Black	.05
Deep chocolate paper	.04
French ultra-marine blue paper	.035
Black cloth	.012
Black velvet	.004

At the head of the list stands white blotting paper, which is really a soft mass of lustrous white fibres. Its coefficient of reflection—.82—is comparable with the coefficient of direct reflection from a mirror; so far, as least, as lights of ordinary intensity are concerned.

White cartridge paper is a good second, and partakes of the same general characteristics.

Of the colored papers only the yellows, and pink so light as to give a strong reflection of white light from the uncolored fibres, have coefficients of diffuse reflection of any considerable magnitude. Very light colors in general diffuse well owing to the uncolored component of the reflected light, but of those at all strongly colored only the yellows are conspicuously luminous. Of course, all of the papers when at all dirty diffuse much less effectively than when clean, and the rough papers, which have the highest coefficients of diffusion, are particularly likely to become dirty. A smooth, clean white board and white painted surfaces generally diffuse pretty well, but lose rapidly in effectiveness as they become soiled. Greens, reds and browns, in all their varieties, have low coefficients, and it is worth noticing that deep ultra-marine blue diffuses even less effectively than black paper coated with lamp-black, which has a diffusion of .05 as against .035 for the blue. Black cloth, with a surface rough compared with the black paper, diffuses very much less light; while black velvet—of which the structure is, as just explained, particularly adapted to suppress light—has a coefficient of diffusion conspicuously less than any of the others. A little dust upon its surface, however, is capable of reflecting a good deal of light.

These coefficients of diffusion have a very important bearing in the illumination of interiors. It is at once obvious that—except in the case of a white interior finish or very pale shade of color—the illumination received by any object is not greatly strengthened by diffused light from the walls. All of the strong colors—particularly if very dark—cut down diffusion to a relatively small amount, although it is very difficult to suppress diffusion with anything like completeness. One of the standing difficulties in photometric work is to coat the walls of the photometer room with a substance so non-reflecting as not to interfere with the measurements. Even lamp black returns as diffused light one-twentieth of that thrown upon it, and painting with anything less lustreless than lamp black would increase the proportion of diffused light very considerably. Walls painted dead black, and auxiliary screens also dead black to cut off the diffused light still more, are the means generally taken to prevent the interference of reflected light with the accuracy of the photometric measurements.

In the case of any diffusing surface—or any reflecting surface whatever for that matter—a second reflection has, at least, approximately the same coefficient of reflection as the first, so that for the two reflections the intensity of the beam that finally escapes is that of the incident beam multiplied by the square of the coefficient of diffusion, and so on for higher powers. Inasmuch as in any enclosed space there is considerable cross reflection of diffused light, the difference in the total amount of illumination due to reflection is even greater than would be indicated by the table of coefficients given; for while the amount of light twice diffused from white paper or paint would be perceptible in the illumination, that twice diffused from paper of a dark color would be comparatively insignificant. The color of the walls, therefore, plays a most important part in practical illumination, for rooms with dark or strongly-colored walls required a very much more liberal use of illuminants than those with white or lightly-tinted walls. The difference is great enough to be a considerable factor in the economics of the question in cases where artistic considerations are not of prime importance. The nature and amount of the effect of the bounding surfaces on general illumination will be discussed in connection with the general consideration of interior lighting.

A. A. A. S. Papers.

In our issue of last week were published abstracts of some of the more important papers read at the recent annual meeting of the American Association for the Advancement of Science. Abstracts of other papers are given below:

Prof. C. D. Child gave in a paper a brief review of an article in the *Physical Review*, for March, 1900, on "A Dissociation Theory of the Electric Arc." It was there shown that the peculiarities of the arc follow very simply from the assumption that the current is carried by ions and that the positive ions move the more rapidly. The objection to this theory was that in all cases of discharge through gases which had been previously studied the negative ions had been shown to move the more rapidly. The present paper describes an experimental proof of the exceptional behavior of the ions in the arc.

The proof is based on J. J. Thomson's method for determining the velocity of ions. If ionization takes place in the space near the positive electrode but not in the space near the negative electrode, the velocity of the ions may be determined by measuring the electric intensity and the current through the latter space.

The integration of Thomson's equation is carried one step further so that in certain cases it is possible to find the velocity simply by determining the potential at the negative electrode and in the space between the two electrodes and the intensity of the current.

The feasibility of Prof. Thomson's method of its extension is shown by an application to the case of the Bunsen burner. The results here found agree with all that has hitherto been known and throw light on the rate at which the velocity of ions decreases as they proceed further from the flame.

Extension of this method by physical reasoning to cases which can not be treated mathematically so as to determine at least whether the velocity of the positive or negative ions is greater.

Application to the electric arc. Description of the arrangement of apparatus. The positive ions here have the greater velocity. Several arrangements of apparatus were made and in each case the results obtained with the arc were opposite to those obtained with a Bunsen burner. As is known with a burner the negative ions move the more rapidly, hence with the arc the positive ones have this property.

It was found that in the case of a very hot oxy-hydrogen flame playing on a carbon pencil the positive ions again have this peculiarity. Without the carbon pencil the negative ions. Metals instead of carbon were tried in the flame but without success, since all, even platinum, melted at too low a temperature.

It is suggested that in the case of a hot platinum wire the positive

ions behave as in the arc. Reasons for thinking thus. However, the rate of discharge from a wire is affected by many conditions such as the length of time that discharge has been taking place, the gas by which the wire had been previously surrounded, etc., so that nothing as yet can be said positively on this point.

It is suggested that the positive ions from a hot metal, the negative ones from a cold metal move the more rapidly. This may be due to the fall of potential at the surface of a cold metal being different from the fall of potential at the surface of at least some hot metals. This would explain the fact that negative electricity is discharged from cold metals by ultra-violet light, and positive by the incandescence of hot metals, it would explain the peculiarities of the arc, and would be in harmony with Elster and Geitel on the difference of potential between a hot and a cold platinum wire.

The work thus far done has been merely qualitative and it is hoped that quantitative work can be done in the future.

Prof. Humphrey read a paper on "The Effect of Solid Dielectrics in the Production of Electric Sparks." Between two electric poles, one positive, the other negative, the air is more sensitive to electrical disturbances next the anode than anywhere else, as shown by the fact that a glass rod or other solid dielectric placed next the positive pole causes an electric spark to pass. Also, a small spark drawn from the cathode produces the same effect—thus proving that sparks result from oscillations when the swing of the impact is in the direction from anode to cathode. These phenomena are probably due to the peculiar state of ionization in the region between the poles.

Mr. L. A. Bauer read a paper entitled "Magnetic Observations on Day of Eclipse, May 28, 1900," of which the following is an abstract made from advance proofs:

Simultaneous readings of the magnetic declination were made under my direction by observers of the Coast and Geodetic Survey at six stations—three situated inside the belt of totality and three outside, covering an area from Alabama to Maryland. The readings were taken from 7 a. m. to 4 p. m.; 75th meridian time, at intervals of one minute from 7 to 11 a. m., and thereafter every five minutes, the temperatures also being read. Moreover, at the principal station, Rocky Mount, North Carolina, in centre of belt of totality, in addition to making declinometer readings under the tent, Eschenhagen variation magnetometers (declination and horizontal intensity) were installed in a tobacco barn, and eye readings were taken with both instruments during same intervals as for the other stations, and besides every fifteen seconds for five minutes about time of totality. Ten observers were engaged in this work, and eight complete series of observations were obtained—seven for declination and one for horizontal intensity. *All of the stations show a magnetic effect, which can not be referred to any other cause than that of the eclipse, the principal effect occurring, like the fall in temperature, some minutes after time of totality.* The effect is as though part of the night hours were interposed among the day hours, *e. g.*, the declination at all of the stations having passed the morning elongation and approaching the mean value of day, is *increased* about 20″—40″, if the declination be east; and *decreased* if the declination be west, whereas, the horizontal intensity approaching at the time its minimum value for the day, is *increased* for a brief period after time of totality. The observations and results will be published in full in a bulletin of the Coast and Geodetic Survey.

In a paper on "Thermodynamics of the Voltaic Cell," Prof. Henry S. Carhart takes a stand in favor of the Helmholtzian as opposed to the Thomson theory as to the origin of the e. m. f. in the voltaic cell, the question being treated both mathematically and experimentally. The Helmholtz principle was applied to the voltaic cell in parts—that is, the positive and negative sides were treated separately. The Daniell cell was chosen, and made of two vertical glass tubes provided with side tubes near the bottom, the two latter being connected by tightly-fitted rubber collars, with a plate of fine glazed porcelain placed between the opening of the tubes, the edges of the porcelain plate being covered with paraffine, after the rubber collars had been joined together with fine iron wire. By means of a storage battery, a reversed current was passed through the cell and the difference of temperatures measured. For measuring temperatures, two thermal couples were used instead of thermometers. With this arrangement it was determined that the temperature difference per second is proportional to the current, as the theory requires, and the observed value of any established temperature difference was found to agree with the calculated value—the Helmholtz theory being thus confirmed.

In a paper by Prof. Edward L. Nichols on "The Visible Radiation of Carbon," a study is given of the physical effects of black and gray carbon, measurements of the spectrum having been made with thermo-elements of platinum and platinum-rhodium. As a result, it was shown that carbon between 1200 degs C. and the melting point of platinum possessed a very different radiating power from that shown by flames in which carbon is the incandescent element. If the latter be considered the normal type of radiation, then a carbon filament may be said to have marked selective emissivity at these temperatures.

Prof. H. C. Parker read a paper on "The Percentage Bridge and Its Applications." This instrument was exhibited for the first time at the meeting. It embodies the percentage principle already described by Mr. Parker before the American Institute of Electrical Engineers, and also several important and interesting novelties in construction, so that in its present form it may be called a universal bridge and it is expected that it will be of considerable use in standardizing laboratories.

The Siemens-Halske Exhibit at the Paris Exposition.

BEYOND question, the country making the finest display at Paris in the field of heavy electrical engineering is Germany, whose generators occupy a very large portion of the foreign section of the generating plant of the Exposition, at the Suffren Avenue end.

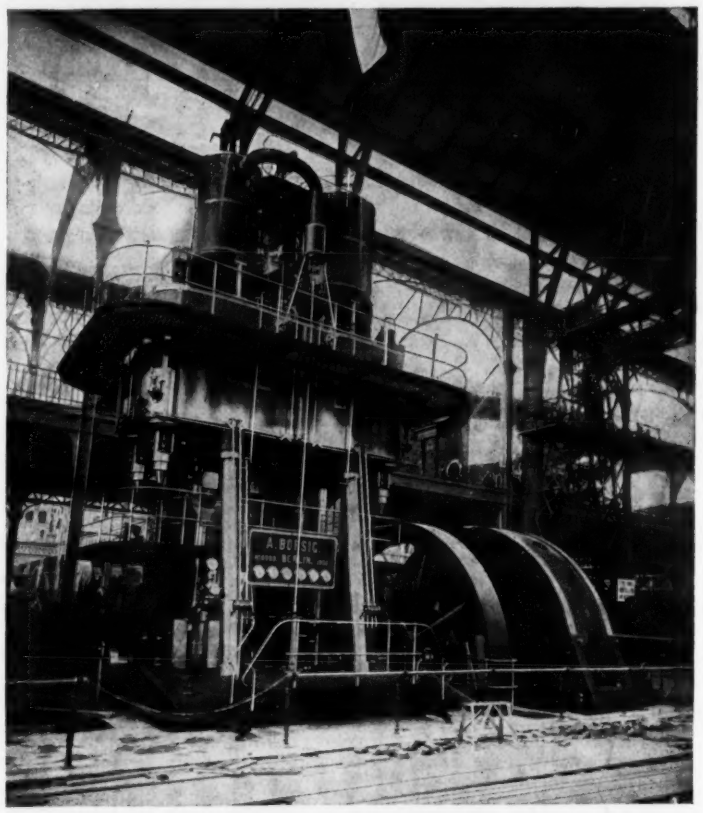


FIG. I.—SIEMENS & HALSKE DYNAMO AND ENGINE.

The German section contains four direct-connected generating sets, with an aggregate capacity of 7500 horse-power. One of these generating units, consisting of a Siemens & Halske 2000-kw, three-phase dynamo, direct connected to a Borsig vertical, triple-expansion engine of 3000 horse-power. The "electrogene" unit is shown herewith. The Borsig engine has four cylinders, of which the two lower ones are the low-pressure cylinders, which work in parallel. The diameter of the low-pressure cylinder is 52.8 in., that of the intermediate-pressure cylinder 46.4 ins., and of the high-pressure cylinder 30 in. The stroke is 48 ins.

The engine is intended for a pressure of 200 lbs. to the square inch. The steam pressure of the Exposition plant is 150 lbs. per square inch, and at this pressure the engine gives 2000 horse-power, running at 83.5 r. p. m. The two cranks of the engine shaft are spaced 180 degs. against each other. The high-pressure piston works together with one of the low-pressure pistons on the same piston rod, while the intermediate-pressure piston works on the same piston rod as the other low-pressure piston. The total height of the machine above the floor is 42 ft.

The dynamo has been designed for a maximum output of 2000 kilowatts. The terminal pressure and the frequency were determined

by the conditions of the Exposition management, and are 2000—2200 volts and 50 p. p. s., respectively. It has 72 poles, and at 83.5 r. p. m. gives the required conditions of current. On a non-inductive circuit it works up to its rated capacity of 2000 kilowatts.

The general principle of construction is that of a stationary armature, and an internal rotating field magnet. The field magnet system consists of a cast-iron ring in two parts, which connects with the hubs by cast-iron spokes, and is keyed on an extension of the engine shaft.

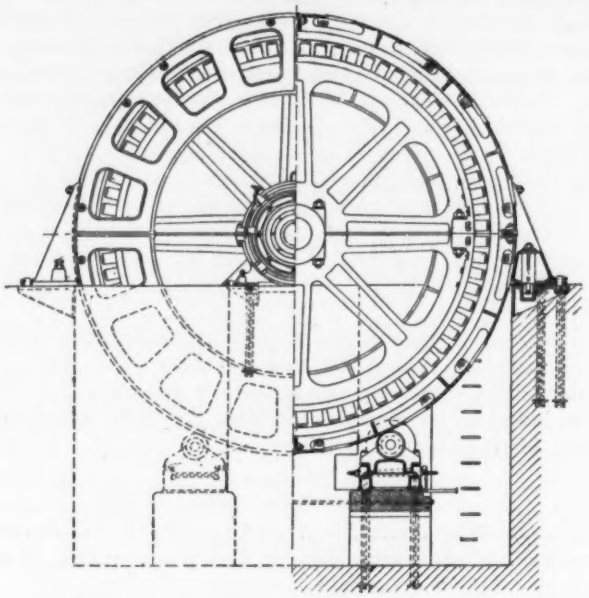


FIG. 2.—SECTIONAL VIEW OF GENERATOR.

The pole pieces consist of iron stampings, held together by three bolts and one steel prism of quadratic cross-section. This steel prism is threaded to receive the screws which connect the pole pieces with the cast-iron pole ring. A prismatic, key-shaped projection of the pole pieces fitting in a corresponding slot in the pole ring, serves to take up the tangential forces.

The winding of the field magnets consists of copper strip of .158 in. x .906 in. cross-section, wound high side up. Each pole has 40 turns. The total weight of the copper in the field winding is 8800 lbs.

To provide for ventilation and cooling of the magnets, the following arrangement has been devised. On the two faces of the field coil, the conductors pass around hollow bronze castings. When the field is in motion, the air passes through these hollow castings in a radial direction, and carries along the heat generated in the coils. For the same purpose, the field magnet cores have a deep slot in the middle,

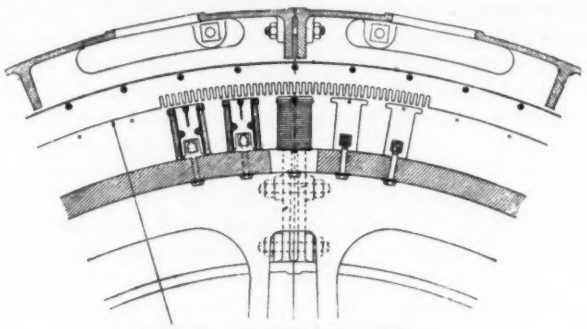


FIG. 3.—DETAILS OF WINDING.

which continually leads fresh air into the space between armature and field pole.

For the excitation of the field poles, a maximum of 270 volts is required, which corresponds to a current of about an equal number of amperes, as the total resistance of the field winding is, in round figures, one ohm. The mean energy consumption for excitation is 28,000 watts; the maximum, 42,500 watts.

Of the armature construction, we may first describe the very interesting mechanical part. The firm has sought to solve the problem of giving the armature a form of greatest mechanical simplicity, and at the same time provide means for accurately centring the armature in the erection of the machine, as well as a ready readjustment, should the wearing of the bearings make this necessary. To attain this end, the following method has been employed. Let us suppose a short, hollow cylinder, resting on two rollers. These rollers can be raised or lowered, singly or simultaneously. It is clear that a simultaneous raising or lowering of these rollers will effect an equal raising or lowering of the cylinder resting on them. But if only one of the two rollers is raised or lowered, or if one is raised at the same time that the other is lowered, the axis of the cylinder will be displaced in a horizontal direction. This simple arrangement permits us, therefore, to displace the cylinder horizontally and vertically within certain limits, and thus centre the cylinder.

What has here been referred to as "the cylinder," is constructed in the following manner. An internal and an external ring, united by strong radial spokes, form a kind of flat crown which is turned off inside and outside. Two such exactly equal crowns are placed parallel and coaxially, one beside the other, and form, with the armature placed intermediately between the two, a solid unit. Each of the two crowns bears on the two rollers in the manner described above. In order that the large cylinder consisting of the two crowns may not turn on its roller bearings, it is screwed down to floor plates, after having been centred. These floor plates also prevent a displacement of the armature in the direction of the shaft. When it is desired to operate the centring apparatus, the screw connection with the floor plates has to be loosened.

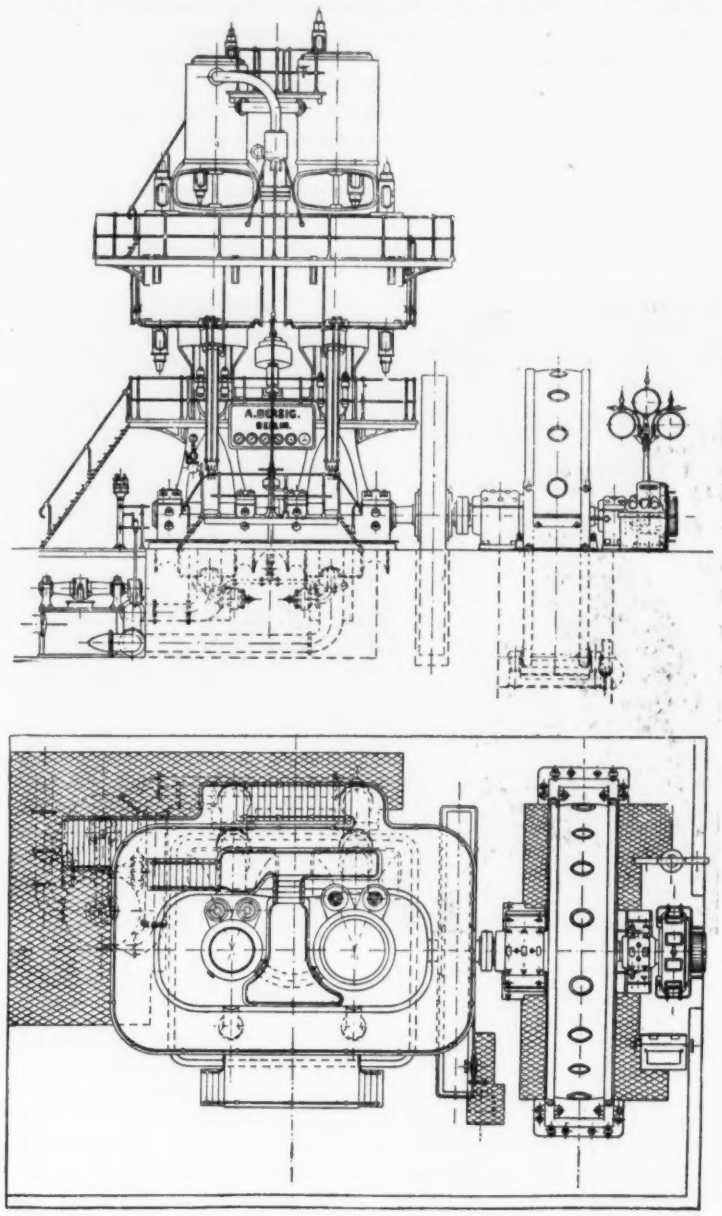


FIG. 4.—ELEVATION AND PLANS OF ENGINE AND GENERATOR.

The armature core, disposed between the two supporting crowns, consists of plates of 20 mils thickness, which are held together by suitable castings. We may mention that the armature, like the supporting crown, is made up of four quadrants. The dimensions of the crown have been so chosen that an appreciable change of form will not take place.

For the winding, the armature has 648 slots of .520 in. width and 2.2 in. depth, in each of which a copper bar of .28 in. by 1.76 in. is placed. The slots have such a form, that after the bar has been put in place, an insulating cover can be pushed into the slots over the bar. The insulation of the copper bars consists of mica pressed directly around the bars. The total weight of the armature copper is 5280 lbs. The total resistance of the armature winding, when warm, is .057 ohm, and the C^2R losses are about 15,000 watts.

The exciter dynamo, an 8-pole, direct-current machine, with two-circuit winding, of 45 kilowatts capacity at 270 volts, is of the external pole type, with drum armature. One of our engravings gives a view of the direct-connected set.

The switching, regulating and controlling apparatus are arranged in the following manner: The product of the machine is measured by an ammeter, a voltmeter and a wattmeter. These three instruments, which are built according to the Ferraris system, have each a diameter of 23½ins., and have a scale on both sides. They are placed on top of a column some 14 ft. high, inside of which the conductors leading to the instruments are concealed. All three instruments are connected to the machine by suitable meter transformers, but their indications show the performance of the machine directly.

The apparatus for switching the machine in and out, and for regulating it, is built together with a switching desk, shown in one of the engravings. On this desk are placed an ammeter and a voltmeter

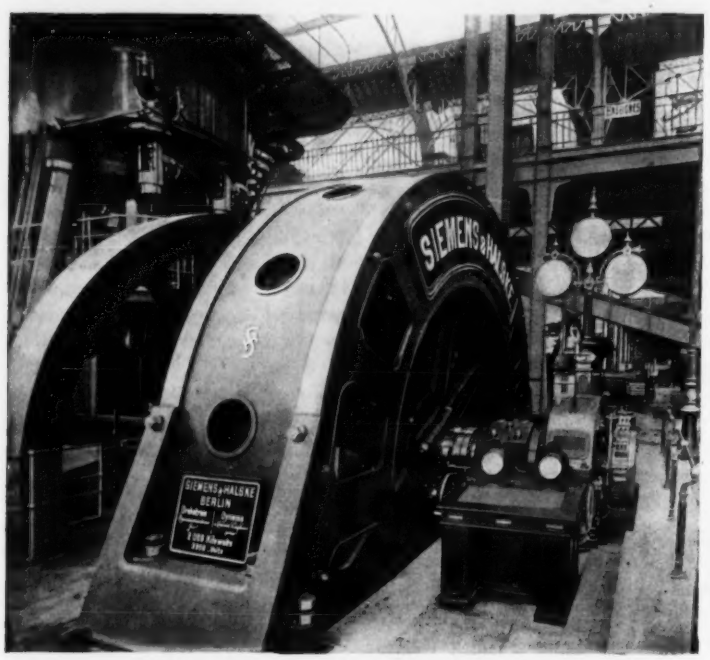


FIG. 5.—GENERATOR, EXCITER AND SWITCHING DESK.

for the exciter. By means of two hand-wheels placed at the sides of the desk, a regulating resistance in the exciter circuit and a three-pole, high-tension tubular switch are operated. These two last-named pieces of apparatus are placed in a pit below the floor, and their operation is effected by means of sprockets and chains. The positions to which these instruments are set are shown by an indicator on the switching desk.

The bedplate for the unit is in two halves, each weighing 63,800 lbs. It was laid Jan. 12, and the machine was ready for operation when the Fair opened.

Schieren Belts at the Exposition.

As already noted in these pages, Chas. A. Schieren & Co. have a very neat display at the Paris Exposition; in fact, it would seem that they are the only American leather belting firm who have had the enterprise to make an exhibit at Paris in their own behalf. Their space is on the main ground floor of Electricity Building, in the United States section, as indicated in the diagram recently shown, and it covers an area of 300 square feet. It is well situated, being on a main aisle through from the Chateau d'Eau to the Agricultural Building and the great Salle des Fêtes; resting in the rear on the French wing of the great steam plant, while it looks out upon several machinery and other exhibits in which belting finds more or less to do. The exhibit includes belts from 72-in., three-ply, weighing 2800 lbs. each, down to 1 in., single-ply belt, which is the smallest made. The company give an excellent idea of all their productions. They exhibit prominently their perforated Electric leather belts, which have been on the American market since 1888, and which are well known from the fact that they run looser with less strain on the bearings and with consequent use of less oil than other types of belt employed for fast-running lighting dynamos and street railway generators.

Chas. A. Schieren & Co. exhibit also their leather link belts, the American joint of which is their invention; main driving bands used in cotton mills and the same thing as employed in large electric-light stations. They exhibit also a roll of 20-in. double belt, short lap and oak bark tanned; a roll of 24-in. double belt, a roll of 30-in. double, a roll of 48-in. double, a roll of 60-in. three-ply, and a roll of 72-in. three-ply leather belting. As extensive tanners of belt leather, they show samples also of their leather hanging on the walls of either side of the exhibit, both in the rough state and in the finished condition. In the same manner, an exhibit is made of lace leather, round belts and other specialties of the concern. The exhibit is in charge of Mr. C. A. Bramm.

It will perhaps be remembered that in our recent account of the Congress Hall at the Exposition, note was made of the fact that in the United States economics section there, a collection is shown of American industrial photographs, including the Dixie tannery of the Chas. A. Schieren Co., at Bristol, Tenn.

PARIS EXPOSITION NOTES.

ATTENDANCE.—The attendance at the Exposition is still increasing, the number of visitors Sunday, June 24, having been 443,757, of whom about 33,000 were at Vincennes.

MILWAUKEE ELECTRIC COMPANY, of Milwaukee, Wis., has on exhibition one of its motors on a Q. & C. saw, to which reference has already been made in these columns.

AUGUST MIETZ, of New York, has on exhibition, in charge of Markt & Company, a 6-hp gas engine and a 4-hp kerosene engine and generator combined, constituting a very neat and compact display.

MR. FRED H. HOLZ, JR., is in charge of the fine machine tool exhibits of the Cincinnati Milling Machine Company, which has spaces both on the Champ de Mars and at Vincennes.

F. E. REED COMPANY, Worcester, Mass., has two exhibits, one on the Champ de Mars and the other at Vincennes, in care of Fenwick Bros & Company, its French agents. The exhibit includes engine lathes in a large variety of sizes, as well as a special 20 x 10 turning lathe, a 10 x 4 screw-cutting, foot-power lathe and a 10 x 3½ wood-turning lathe for schools. The Vincennes exhibit includes large engine lathes in operation.

JEFFREY MANUFACTURING COMPANY, of Columbus, Ohio, has a fine exhibit at Vincennes, in charge of Mr. S. B. Belden, Jr. It includes a compressed air coal-mining machine, an electric chain coal-mining machine, an electric drill for working in coal and shale, a "Giant" air drill for coal and shale, and a full assortment of chain belting, elevator buckets, cast-iron and wrought-iron screw conveyors, and sections of troughs for different forms of elevating and conveying machinery for handling all classes of material. The company has also an electric mine and mill locomotive.

HOURS OF BUSINESS.—Notice was posted in the American section a few days ago, that all the palaces and buildings comprising the Exposition are open to the public from 8 a. m. to 7 p. m., during which time all the exhibits should be visible for inspection. This request applies to Sunday as well as week days. It may be mentioned in this connection, that many of the smaller exhibits were being covered up at about 5 o'clock, and that on Sundays most of the English exhibits in the Court of Honor and many of the American exhibits in Electricity Building were hidden from view by wrappings. There have been some complaints about this.

LAUNCH CONTEST.—The competition of motor-propelled boats, which took place June 23 and 24, in the Bassin d'Argenteuil, and the organization of which was intrusted by the Commissioner-General of the Exposition to the Helice Club of France, was a brilliant success. Gasolene launches carried away the most honors, gaining in five out of eight races. Steam launches won two races, while the only electric launch entered came in for the last, having triumphed easily over its competitors. The first day the electric launch did not win on account of following a wrong route. Forty-eight launches took part in the various races.

THE PALAIS DES ILLUSIONS, or the Palais of Mirrors, is a rather large room in the gallery of the Palais of Electricity, having its entrance near the Austrian Court of Honor, and its exit near the Swiss Court of Honor. The palais consists of a large hexagonal space, with an arched dome, and its walls are made up of huge mirrors. In the corners of the walls are placed two cylindrical columns of frosted glass which are internally illuminated with multi-colored incandescent lamps. Such lamps also outline the juncture of the dome and walls and the various panels of the dome. The reflection of the walls gives the impression of an infinite space with halls of marble columns and arched ceilings in every direction, and the sudden changes in illumination are very pretty indeed.

ACCIDENTS in the installations of the Champ de Mars succeed each other with a deplorable rapidity. On Monday, the 25th, at about 2 o'clock in the afternoon, a 12-in water pipe, supplying the boilers in the French section of the boiler house, gave way with considerable noise, and for a time water escaped in large streams. Considerable damage might have been done in surrounding exhibits, had it not been possible to shut off the valves immediately. As it was, the boilers in this section had to shut down, and no machines were running in the Bourdonnais section of the Palais de l'Electricité until 5 o'clock, when a connection to the water mains of the foreign section permitted the boilers to start up again. As a result of this accident, a repetition to representatives of the press and a part of the personnel of the Exposition, at the Palais des Illusions, was retarded a couple of hours, and the lighting effects and luminous fountains of the Chateau d'Eau were operated only in part that evening.

Voltaic Cells.

BY ALFRED G. DELL.

In working with voltaic cells, I have rarely found two cells that would act exactly alike, one to all appearances polarizing sooner than the other, though the solution used in each cell be exactly the same. With two cells, zinc-carbon with bichromate of potash as a depolarizer, I have found that one would work for some time before there was any sign of polarization, while the other would show apparent polarization when it had been in use but a few minutes. The zinc and solution in the two were exactly alike. The carbon that polarized sooner was put in lately, while the other had been used for probably a year.

Now, if the bichromate is the only agent that acts on a depolarizer, the two should act alike, excepting possibly that one might furnish a larger current than the other on account of a difference in the connections, either made when the carbons were first put in, or caused by the currents across the connections.

The connections in the two mentioned above were made at first equally good, and the current at start was equally good, but it is remarkable that seeming polarization should set in sooner in one than the other.

It cannot be local action in the carbons that would cause a resistance, as the carbons are in the solution when not in operation and the zincs are raised up out of the solution. When the zincs are lowered into the solution, if local action in the carbons were the cause, the fall-off should take place at once, and not start with a current equal to that of the better cell, and then fall off in a few minutes.

I have often found a cell which, after working well for a time, would suddenly get in a condition such that the time for apparent polarization to commence would be shortened; and I have also found just the reverse. I have found the ordinary salammoniac cells work the same way. I have two that I used some time ago; one was good and the other bad, though both to all appearances were alike in every respect.

These remarks apply to the cells used separately, and not joined up in series or parallel. Of course, when joined up in series, cells polarize much sooner than when worked separately, and it would not be readily discovered that one or more was polarizing too fast, though the effect would influence the current.

Can it be that the self-induced impulses that dart around the circuit (the cells being used with coils, and the current being rapidly interrupted) produce some changes at the connections of some carbons and none or little at others? If so, it may be that an increase in resistance at the carbon connections is the cause, the increased resistance disappearing when the cells are left idle for a little, as in the experiments referred to above.

Society for the Promotion of Engineering Education.

At the annual meeting of this society, as reported in these pages last week, Mr. Robert Fletcher read a paper on "The Present Status and Tendencies of Engineering Education in America." This was a review of the field, appropriate to the close of the century, and considered: (1) Some aspects of the schools or colleges of engineering today, as to aims and methods; relation of culture studies to undergraduate technical courses and results. (2) Some tendencies, favorable or otherwise, such as injurious results and influence of mistaken ideas; large range of studies, whether compatible with thoroughness, etc., closing with the question of making the technical and general training broad enough to produce not simply the technical graduate, but a "well-educated man."

William G. Raymond read a paper on "The Promotion of Engineering Education," in which he criticized the society, and created something of a breeze by the suggestion that if the result of the methods adopted is found to be the prevention rather than the promotion of engineering education, it were better to discontinue the society. After some discussion, he replied to the effect that he did not intend any aspersion on the society, but wished to put the case strongly enough to arouse attention and invite discussion.

Walter B. Snow read a paper on "The Relations of the Technical School and the Manufacturer." Regarding the school as the producer and the manufacturer as the consumer, he favored closer cooperation with the purpose of securing product better adapted to the requirements. Manufacturers should visit the schools and present their ideas to students. Students should be encouraged to visit the workshops. The products of nearby factories might well be used by professors and their merits explained to students, even if this did incidentally result in some advertising of particular wares.

A paper was presented by H. S. Jacoby on "Minor Considerations Affecting the Arrangement of a Course of Study in Civil Engineering." Some questions considered were as to the proportion of hours of recitation, drawing, field work, etc., and as to how many studies to prosecute at once. At Cornell, the hours, after making proper reductions to compensate for the different valuations put on different exercises, average 27.6 per week for the entire course; being 20.7 the first year, then 29.4, 27.7 and 22.8. He favored reducing the number of simultaneous studies to three or four, instead of attempting to keep six or eight courses under way at once. This suggestion was commended in the discussion by Messrs. Raymond, Johnson, Merriman and Hazen. Prof. Jacoby said the University of Chicago had adopted it. Prof. Raymond said that as long ago as 1824, at Troy, Amos Eaton had two solid studies in the morning and "scholastic amusement" in the afternoon.

Amos Marston presented a paper on "Original Investigations by Technical Schools, a Duty to the Public and the Profession," read by Prof. Bissell. Original scientific investigation is of great value, and is largely conducted by engineering schools, but they seldom have sufficient apparatus and appliances, hence should avail themselves of the help of manufacturers in carrying out researches of two general kinds; first, those mainly of professional interest and value; secondly, those whose results have also high commercial and industrial value. In a new country with undeveloped resources, such as this, much can be done in this way.

Harry W. Tyler, chairman of the committee on entrance requirements for engineering colleges, reported favoring continued adherence to the recommendations made three years ago, namely, the formulation of a definite outline of work, and sending it to each engineering college, together with a statement of the principles governing admission to the colleges by certificate; also, recommending co-operation of all colleges by interchange of evidences of preparation; and finally that the committee submit annual reports.

This report was presented to the National Educational Association at the meeting at Charleston.

James M. White read a paper on "The Development and Present Status of Architectural Education," giving data of home and foreign schools, and discussion of courses of study, responsibility and influence of architectural schools and societies, State license laws, and the qualities essential for the making of an architect.

In the absence of authors, the following were read either wholly or by title, viz.: Arthur E. Haynes, on "What Should Be the Characteristic Features of a Course of Mathematics for Engineering Students?" George A. Goodenough, on "The Possibilities of Correspondence Instruction." William F. M. Goss, on "The Practicability of an Inter-

change of Students Between the Laboratories of Engineering Schools." William S. Aldrich, on "Operating Work as a Feature of Electrical Laboratory Training." Charles R. Richards, on "The Projection Lantern in Engineering Education."

Discussion of Prof. Haynes' paper showed a consensus of opinion in favor of beginning study of higher mathematics before completing the lower branches, *e. g.*, take elementary calculus before trigonometry, and begin integral calculus soon after mastering the elements of differential; also begin all these branches before completing higher algebra.

As for correspondence schools, the opinion was expressed that they might very advantageously be conducted by the State.

The officers elected were: President, Frank O. Marvin, Lawrence, Kan.; first vice-president, Thomas Gray, Terre Haute, Ind.; second vice-president, Albert Kingsbury, Worcester, Mass.; secretary, Henry S. Jacoby, of Ithaca; treasurer, Clarence A. Waldo, Lafayette, Ind.; council, D. C. Jackson, Madison, Wis.; Edgar Marburg, Philadelphia, Pa.; John P. Brooks, Lexington, Ky.; I. C. Nagle, College Station, Tex.; A. L. Williston, Brooklyn, N. Y.; N. C. Ricker, Urbana, Ill., R. S. Woodward, New York City.

Hutin and Leblanc Patents on Alternator Excitation.

In a patent granted last year Hutin and Leblanc described a method of exciting alternating current generators, in which the exciter has a movable field in shunt with the exciter armature, and another movable field at right angles to this; the circuit of the latter being in series with the armature circuit of the alternator. In addition, the armature of the exciter has a circuit which is wound about the two movable field circuits, and attached to a commutator. The two movable field circuits and the armature circuit, which constitute a single, mechanical structure, revolve within an exterior iron ring, which ring merely acts to close the magnetic circuit of any magnetic flux generated. This ring has a winding, called a compensating winding, which may be considered a negative armature winding, producing a flux at right angles to that which would be required in the case of a true field winding, and acting to compensate for, or counteract, the counter m. m. f. due to armature reaction. The compensating winding is mounted in series with the brushes of the commutator, and these in turn are placed in series with the field winding of the alternator.

When the two movable field circuits of the exciter are wound in this manner, it is found that a perfect system of excitation and regulation is produced; that is to say, a current which is supplied from the armature circuits of the alternator to the movable field circuits of the exciter, under the varying conditions of load and lead and lag of current, will cause the exciter to supply such currents as will produce a mathematically-correct regulation. Furthermore, when a number of these alternators and exciters are used in the same network, having once been put in step, they will not fall out of step. This is due to the fact that when a given alternator is running in synchronism with the system, the brushes of the commutator of the exciter will supply direct current to the alternator field; and in case of departure from synchronism, the brushes of the exciter will no longer supply direct current, but will supply alternating current to the exciter field of a frequency which exactly compensates for the departure from synchronism.

According to the prior patent it was necessary that mechanical or electrical gearing be employed to compel the exciter to turn in synchronism with the alternator, and the basis of an invention for which a patent was granted July 10, is to suppress such connection and have the exciter keep in synchronism with the alternator of its own accord. To this end another circuit is added to the compensating circuit of the exciter, consisting of a field winding on a stationary ring, which develops a flux in the same direction but of opposite sign to that developed by the armature, thus compensating for armature reaction, and giving also a flux at right angles thereto, which is the true field flux tending to drive the armature. By this means an exciter when once synchronized will continue to remain in step with the alternator. In this case an exciter may be compared to a rotary converter, which receives alternating current of a definite frequency in its movable field-winding from the alternator, and which supplies in turn either a direct or an alternating current of low frequency from its commutator field to the alternator field, and in such an amount as to produce a perfect regulation.

Another patent issued the same date has for an object to modify the above-described exciter, by dispensing with the use of rings and brushes and at the same time make it possible in certain cases to dispense with the transformers in the circuits leading from the alternator armatures to the exciter field, which have been previously used. To this end the series and shunt exciter field windings are fixed instead of movable.

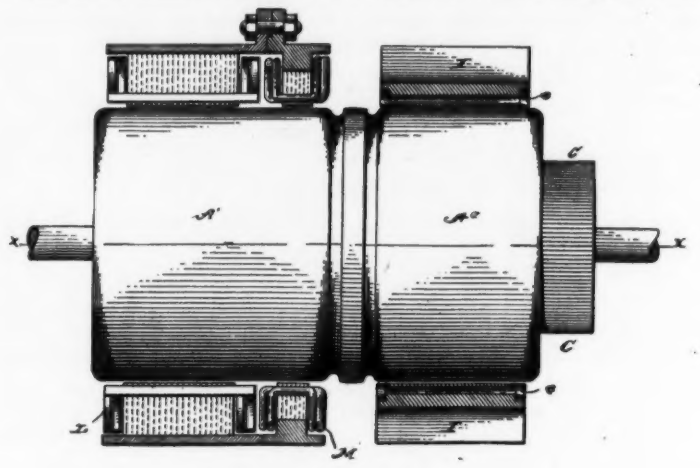
Referring to the accompanying illustration, the movable part of the exciter is composed of two cores, like those of a direct-current machine mounted upon the same shaft. The windings of the two cores, however, are connected with each other, and to the commutator, *G*, mounted on the same shaft.

The armature, A^2, is surrounded by the driving field, *I*, of the exciter, which acts upon the ring carrying the circuits, A^2 and has its circuit mounted in series with the brushes, *D*, resting on the commutator of the exciter, these brushes being in turn mounted in series with the field of the alternator to be excited.

The sections of one armature winding are connected with the sections of the neighboring winding, so as to produce an "image winding," by which is meant any winding by means of which a field rotating in one direction of the winding is converted into a field rotating in another direction in another section of the winding.

About the arm, A^2, is a ring, *I*, which, together with the winding of A^2 serves to drive the exciter.

About the armature, A^1, are two rings, *L*, *M*, each carrying wind-



HUTIN AND LEBLANC'S EXCITER.

ings. The circuits of the *L* are connected in series with the corresponding circuits of the alternator armature, and the circuits of the winding *M* are mounted in shunt to the circuits of the alternator armature; moreover, the circuits, *L*, *M*, are dephased with relation to each other. The sections of the magnetic circuits of the rings carrying the windings, *L*, *M*, are of such a size that saturation will be produced in one or the other of these rings when the voltage of the generator or its loading shall have taken a determinate value. As illustrated, the object is attained by making the ring carrying the shunt winding, *M*, smaller than the ring carrying the series winding, *L*.

Assuming that sections A^1 and A^2 are of negligible resistance and have the same number of coils mounted in opposition, if A^1 is subjected to the effect of a magnetizing force which engenders in it a variable flux, the circuit A^2, will necessarily be the seat of a variable flux, which at each instant of time is exactly equal in amount but of opposite sign. The least difference between the fluxes will determine an e. m. f. in the total circuit formed by the union of the two circuits, A^1, A^2, which will generate a wattless current, which will necessitate the equality of the two fluxes by diminishing one to augment the other. It follows that to any variable flux developed in the ring carry A^1, there corresponds in the ring carrying A^2, a flux equal in amount but of opposite sign.

To resume, the winding, *L*, is a stationary means for creating a rotary field varying in magnitude and phase with the variations in quantity and phase of the current supplied by the alternator, just as the winding, *M*, is a stationary means for creating a rotary field of constant magnitude. Put in another way, one of these windings produces a practically constant field, and the other produces a field variable with the current in the armature of the alternator. The exciter may be looked upon as a rotary converter receiving alter-

nating current into its field windings, *L, M*, and delivering constant or slowly-alternating currents into the circuits leading from the brushes resting on its commutator. Should an alternator not be running in synchronism with the other alternators of the circuit, then the exciter commutator will supply a slowly-alternating current to the field of the alternator, and having a frequency equal to the slip, the effect of which will be to supply alternating currents of the proper frequency to the exciter fields, so as to keep the parts in step.

Speed-Equalizing Device.

A patent granted July 10 to Alexander D. Lunt relates to a means for equalizing the speed of shafts, machines, or other rotating bodies, and particularly applicable for preventing the hunting of synchronous motors, rotary converters, or other synchronously-operated electric machines. Briefly, the means consists of a fly-wheel mounted loosely on a shaft on one side of the rim of which are electromagnets; opposite the electromagnets is a copper disk keyed to the shaft. In normal operation the friction of the fly-wheel on its bearing will generally be sufficient to maintain it in rotation in fixed relation to the copper disk. When, however, the speed tends to fluctuate, the fly-wheel, owing to its large inertia, will continue its regular rate of rotation, thereby causing a relative movement between the fly-wheel and its shaft, and a consequent shifting of lines of force along the disk. This latter action will result in generating electric currents in the disk, which produce a powerful braking action, and thus restrain the shaft and the parts to which it is connected from fluctuating in speed, either above or below a regular rate of rotation. That is to say, the disk constitutes a closed electric circuit which dissipates the electrical energy produced by the relative motion between itself and the fly-wheel carrying the electromagnets, thereby acting as a damping device, the effect of which is the more powerful the greater the tendency to deviation from normal speed. As illustrated, the fly-wheel is grooved on the rim face opposite the copper disk; windings filling these grooves are connected with two collecting rings mounted on the hub of the fly-wheel, through which direct current from an exterior source is supplied to the windings. The edge of the disk furthest away from the fly-wheel is made of magnetic material which serves to complete a magnetic circuit for the lines from the pole pieces on the fly-wheel.

CURRENT NEWS AND NOTES.

ENGLISH PACIFIC CABLE.—A London despatch reports that tenders for laying a Pacific cable will be invited at once by the English Government.

SUBSTITUTING DYNAMOS FOR GALVANIC BATTERIES.—The Western Union Telegraph Company is installing 11 dynamos in its Milwaukee main office, to supersede the 4000 cells battery heretofore used. The dynamos range in voltage from 50 to 150 volts.

WIRELESS TELEGRAPHY.—A despatch received by Gen. A. W. Greely, at Washington, conveys the intelligence that Signal Corps wireless telegraph stations have been established and are in successful operation between Alcatraz Island, in San Francisco harbor, and Fort Mason.

PRIZE FOR BEST INSULATING GLOVES.—The Association des Industrielles, of France, has offered a prize of 1000 francs for the best insulating gloves for the use of linemen. The office of the Association is at No. 3 Rue de Lutsce, Paris, where further information on the subject may be obtained.

PROF. S. SHELDON, Ph.D., of the Brooklyn Polytechnic, has in press the first volume of a book entitled, "Dynamo Electric Machinery." It will deal with direct-current machines. Mr. Hobart Mason has assisted him in the work. D. Van Nostrand Company will be the publishers and will issue the book in the autumn.

CANADIAN ELECTRICAL ASSOCIATION CONVENTION.—The City Council of Kingston, Ont., will invite the Canadian Electrical Association to hold its annual convention there in August next. The convention was to have been held at Ottawa, but the fire in that city prevented. The Kingston City Council will vote a sum of money for the entertainment of the Association.

CHARGING STATIONS.—In its new Year Book, the Automobile Club of America proposes, as a beginning, to give as fully as possible a list of charging stations in the vicinity of New York, Boston and Philadelphia. Such data should be sent to Mr. S. M. Butler, 95 Liberty Street, at an early date. We commend the plan to our readers, and would request their prompt co-operation.

INTERNATIONAL ASSOCIATION FOR TESTING MATERIALS.—The third annual meeting of the American Section of the International Association for the Testing of Materials will be held in New York, Oct. 25-27. At this meeting reports of a number of committees as to proposed standard specifications will be submitted for discussion. Among these are specifications for steel axles, steel forgings, steel castings and wrought iron.

STREET LIGHTING.—In the abstract of the paper presented by Mr. H. H. Wait before the recent convention of the Northwestern Electrical Association, several inaccuracies occur. In the second paragraph, on Page 12, second line, "with arc lamps 100 ft. apart" should read, "with arc lamps 300 ft. apart." In the paragraph following the phrase "on the basis of low minimum values *low* arc lamps cannot compete with incandescent lamps," the second "low" should be omitted

A NEW CANSO CABLE.—The cable steamship Silvertown, belonging to the Telegraph Construction & Maintenance Company, of London, will leave New York harbor this week to begin the work of laying the Commercial Cable Company's new cable between Coney Island and Fox Bay, Canso, N. S. The cable is to make connection at that point with the cable which the Faraday recently laid to the Azores. Manager-Director H. K. Gray is in charge on board the Silvertown, and will remain there until the 950 knots of cable have been placed.

ELECTRIC TRACTION BALLOON.—A curious application of electric traction is described in a patent issued July 10, to M. J. A. Deydier, of Nyons, France, consisting in an arrangement for towing a traction balloon by means of electric traction. The patentee states that by this means transportation by balloons may be realized even at high rates of speed and notwithstanding the direction of the wind, except in cases of storm. The balloon is held by cables secured to wheels running on the underside of a track, and is towed by an electric truck running on railway tracks.

LONG-DISTANCE TRANSMISSION IN MANITOBA.—A company, composed of Winnipeg capitalists and business men, has been organized under the name of the Lac du Bonnet Company, to transmit electricity for light and power, from a water-power at Lac du Bonnet to the city of Winnipeg, a distance of 62 miles, at a voltage of 40,000 volts. Plans have been prepared for the power-house and plant. On the main floor will be placed 20 direct-connected generators, each of 1,000 kw capacity. Step-up transformers will be employed to raise the voltage to 40,000 volts.

BRAZIL CABLE.—It is stated that the lines of cable between Para and Pernambuco are to be increased, in order to take care of the growing traffic between those points, Europe and the United States. A meeting of the shareholders of the "Amazon Telegraph Company" was recently held at London. Mr. D. H. Goodsall, who presided at the meeting, stated that, owing to the difficulties in maintaining the cables, the accounts of the company showed a deficit of £29,000. Repairs were being made in the cables, and at three places the line was being transferred to another route. It was hoped by these changes that the cable would be able to be maintained permanently in its present position. The company has obtained from the State of Amazonas a concession for a land line, which it expects to establish soon.

INCANDESCENT LIGHT PHOTOGRAPHY.—A New York photographer is now using incandescent lamps in photography. Fastened to the ceiling over the sitter's head is a movable apparatus

of umbrella shape. This contains 21 incandescent lamps. The normal candle-power of 20 of those lamps is 100 cp. The lamp in the centre of the umbrella is 150 cp. There is a white covering on the umbrella which tends to disseminate the light evenly. When focusing four of these lights are used to get the shadow effect. When all is ready all the lights are turned on. A two-second exposure is allowed, and during the two seconds the voltage is almost trebled. The increase in voltage is not healthy for the lamps, but the photographer says: "Work done properly by incandescent light cannot be distinguished from work done in sunlight."

DIAMAGNETIC SEPARATION.—Several patents were issued July 10 to Elmer Gates on a method for separating diamagnetic substances from the constituents of granular or powdered mixtures. The characteristic feature consists in feeding the mixture into the intense part of a magnetic field and prolonging the period during which it is subjected to the influence of the field, until the slight initial tendency of the diamagnetic particles to separate becomes sufficient to effect that purpose. The method is based upon the principle that when freely movable granular materials or mixtures containing particles of varying degrees of diamagnetic susceptibility are introduced into a magnetic field, the diamagnetic particles of weakest susceptibility tend to seek the centre of the magnetic zone, while the diamagnetic particles of least susceptibility tend to move away from the centre toward the outer edges of the zone. One of the objects of the invention is stated to be the separation of gold from sand or other pulverized mixture in which it is present. Another patent describes a form of apparatus based upon what is stated to be the discovery that the tendency of diamagnetic substances to seek the weaker portion of the magnetic field is considerably increased if the particles or the mixtures to be separated are statically charged during the transit to the field.

LETTER TO THE EDITORS.

Storage Battery Plates.

To the Editors of Electrical World and Engineer:

Sirs:—Since writing the article on "Electric Lighting of Railway Trains," which appeared in ELECTRICAL WORLD AND ENGINEER of July 7, I find that the American battery is formed by an electro-chemical process and is not a pasted plate, as was stated on page 6; the American company claiming to be the first in this country to make a plate from rolled lead and to form the same electro-chemically. Kindly make the correction.

GEO. D. SHEPARDSON.

MINNEAPOLIS, MINN.

DIGEST
OF
CURRENT ELECTRICAL LITERATURE.

Temporarily Conducted by E. F. ROEBER, Ph. D.

DYNAMOS. MOTORS AND TRANSFORMERS.

Single-Phase Motors.—WILMSHURST.—An illustrated paper, read before the Brit. Municipal Elec. Ass'n. He first shows that the prejudice against the single-phase motor has its root not in any inherent defect in the motor, but in the unsuitable nature of the appliances used. He refers to the city of Frankfort, Germany, where, on March 31, 1899, there were single-phase motors of an aggregate of no less than 4532 horse-power connected to the mains, while the proportion of units sold for power purposes to units sold for lighting was 4 to 3. The largest motors are of 750 horse-power, of which there are three; they are of the synchronous type, and coupled to direct-current generators to supply the current for the tramways; all the other motors are of the induction type, the largest being of 90 horse-power; the largest motors are run from separate transformers fed from the nearest feeders, and the smaller sizes take current direct from the low-tension network, while the steadiness of the light leaves nothing to be desired. The municipality of Derby, Great Britain, has within the last few months commenced letting out single-phase motors on hire, with gratifying results; at present motors equivalent to about 200 horse-power have been connected, of various sizes up to 30 horse-power, and the units sold for power during the year have amounted to about 12 per cent of the total units sold. He gives briefly the chief characteristics of the single-phase motor, and gives in a table the results of tests made to compare the efficiencies of direct current, single-phase and three-phase currents; the polyphase motor outstrips both its competitors in point of efficiency; he "would suggest that, should a transformer or other appliance be placed on the market which without moving parts would convert a single-phase into a polyphase current, in the same manner that a two-phase can be converted into a three-phase current, in this direction may lie the solution of the motor problem." (Steinmetz, Alternating Current Phenomena, 2d Ed., page 384, remarks that in the transformation the primary system must have the same flow of power, as the secondary system, and that the transformer is an apparatus not able to store energy and thereby to change the nature of the flow of power, which shows the futility of producing symmetrical balanced polyphase systems by transformation from the unbalanced single-phase system without additional apparatus able to store energy efficiently, as revolving machinery.) In the discussion which followed, Ferranti was the principal speaker in favor of the single-phase motor; "he gave some interesting details of experiments with condensers which would to a large extent solve the difficulties regarding the single-phase motors;" these experiments are, however, not described.—Lond. *Elec. Eng.* and *Elec. Rev.*, June 29.

Single-Phase Induction Motor.—EICHBERG.—A paper, illustrated by diagrams, in which he shows that a theoretically correct method of resolving the oscillating field of the single-phase motor into two rotary fields gives results agreeing with the facts, and yields a clear insight into the action of the single-phase motor. He resolves the ampere windings which produce the oscillating field into two equal halves, and adds two imaginary windings, their plane being perpendicular to the plane of the real windings; each of the two imaginary windings is in form identical with one-half of the real windings, but the two equal imaginary windings are wound in opposite directions, so that, with equal current in both, the sum of the ampere turns of the imaginary windings is zero. He then combines one-half of the real ampere turns with one of the imaginary ampere turns, and the other half of the real ampere turns with the other imaginary ampere turns, and so obtains two polyphase windings connected in series instead of the one single-phase winding. Two such polyphase windings, connected in series, behave exactly like two transformers connected in series, if the sum of their primary e. m. fs. is constant. Upon these considerations he bases his theory of the single-phase motor; he uses the graphical method. The article is, however, too mathematical to be further abstracted here.—*Elek. Zeit.*, June 14.

REFERENCES.

Dynamo Tests.—WAGNER.—A long, illustrated, French abstract of the German article on tests made in the electric station of Zürich (Digest, Mar. 31).—*L'Eclairage Elec.*, May 26.

Starting Devices for Motors.—See the abstract of the paper of Prussman on the maintenance of motors on hire from a central station, under Installations.

LIGHTS AND LIGHTING.

Canal Lighting.—FUELSCHER.—An article on the lighting of the Kaiser Wilhelm canal in Germany by incandescent lamps connected in series, 25-cp lamps being placed 274 yards apart along the canal, which is four miles long. There are two separate stations, one for each half of the canal, and four separate circuits, two from each station, one for each side of the canal. Alternating current at 2000 volts is generated in the stations and transformed up to 7500 volts. On each circuit there are 240 incandescent lamps in series, each requiring 25 volts. Each lamp is shunted by a choking coil, designed so that if a lamp is broken no alteration is required to be made in the voltage at the station until the breakages amount to more than one-third of the number of lamps in each circuit.—*Zeit. fuer Banwesen*, 1899, p. 621; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 140, pt. 2.

REFERENCES.

Choice of Arc Lamps.—STINE.—A comparison of direct-current open arcs with direct-current and alternating-current enclosed arcs, with candle-power curves and diagrams showing the watts consumed at the arc.—*Amer. Elec.*, July.

Car Lighting.—An illustrated description of the Gould electric car lighting system.—*Elec. Rev.*, July 4.

POWER.

Electrical Equipment in Mining Service.—MCALLISTER.—An illustrated description of the equipment of the Eureka Mines near Windber, Pa. Five mines are equipped with locomotives, and the generating equipment is divided up between three plants, the three being connected in parallel, and feeders run to the two mines which have no generating plants. A peculiarity of the equipment is the connection of a G. E. compound-wound generator in parallel with a Thomson-Ryan machine. The equalizer lead of the Thomson-Ryan dynamo is tapped into an intermediate point in its series winding, so that the resistance of the winding from the tap to the bus-bar is the same as the series winding of the G. E. generator. There are four G. E. and four Thomson-Ryan dynamos, all direct connected.—*Amer. Elec.*, July.

REFERENCES.

Power Transmission.—PERKINS.—An illustrated article on Stanley installations in Canada. The Chambly transmission to Montreal, the plants of the Cataract Power Co. of Hamilton, and of the Monmorency Electric Power Co. are briefly described.—*Jour. of Elec.*, June.

Foundry Cranes.—HORNER.—A very long, well-illustrated description of the different types of cranes used in foundries. After a discussion of hand, steam-driven and hydraulic cranes, he points out the leading characteristics possessed by the most advanced types of reversible, three-motor electric travelers.—*Cassier's Mag.*, July.

Gas Engines for Central Stations.—A brief paper, by Small, read before the Western Gas Association; also communications by McDonald and Dunbar, describing electric plants where gas engines are in successful operation. In a brief communication by Wallace, an electric plant was referred to, where gas engines had not been satisfactory. In the discussion which followed, the reasons of that failure were discussed. Generally the speakers were much in favor of the use of gas engines.—*Prog. Age*, June 15.

Electricity in the Navy.—DARY.—A description of the Schneider-Canet electric system of handling the turrets and guns on battleships.—*L'Elec.*, June 16.

TRACTION.

Tramway Exposition.—An illustrated article on the International Tramways and Light Railways Exposition in London. There are two forms of "plastic rail bond" exhibited, the principal agent in both being the Edison-Brown plastic alloy. A relay brake for use on tram cars is shown, an ordinary form of brake being applied by a chain wound up on a drum, which is rotated by a friction clutch that engages with one of the running wheels, and can be put on very gradually or with great rapidity, so that the momentum of the car supplies the force with which the brake is applied, and the action of the friction clutch is that of a relay; it is claimed that a fully-loaded tram car can be stopped on an emergency from a speed of ten miles per hour in two yards. Other exhibits are trolley poles designed so that the upward effort does not increase as the pole is depressed, but remains constant within working limits; a complete tramway installation of the Westinghouse Co. In a maximum-current cut-out of the Helios Co., the maximum current energizes an electromagnet which, attracting an armature, throws out the main switch, the current being thereby shunted through a high-resistance carbon switch, which is subsequently broken, thereby diminishing sparking; the novel feature is that, as long as the short circuit or other cause of abnormal current exists, the switch cannot be closed, which is accomplished as follows: on attempting to close the switch, the carbon contacts are first made; this energizes the electromagnet, which attracts its armature, producing a lock of such a kind that the main switch cannot be closed. Witting Brothers exhibit an alternating-current motor and a lightning arrester, which are described.—Lond. *Elec.*, *Elec. Rev.*, *Elec. Eng.*, June 29; *Lightning*, June 28.

Polyphase Traction.—GIBSON.—A communication referring to the use of polyphase motors for traction. He considers the case of two polyphase motors, star wound, of the same size and voltage, but one having closed rotor circuits and the other fitted with three slip-rings, also a three-phase star winding to the rotor. The latter, which we will call A, is attached in the ordinary way with a switch to a source of supply, and its three slip-rings on the rotor are connected to the stator winding of B motor, whose rotor winding is a closed one. On closing the switch, A and B start off together, but B soon comes to rest, while A runs on at a speed near to synchronism. If these two motors were connected rigidly by their axles, or were in place underneath a tram car, it appears to me that something like the effect of series working could be obtained by arranging the windings for it, so that after half-speed was reached, each motor could be thrown direct on to the mains with its rotor on short circuit. He discusses this further, and suggests for trunk railroads "to collect current at high-tension, three-phase, say 3000 volts, and place the transformers on the train; also a motor generator, having the cars fitted with the much-loved 500-volt series motor."—Lond. *Elec. Rev.*, June 29.

Berlin Tramways.—A long, well-illustrated article on the Great Berlin Railway Co., which has a capital of $16,750,000, and carried last year 223,700,000 passengers. Experiments were made by this company with accumulator cars in 1894, but it was not until 1896 that the electric installation of the road really commenced, in which year 50 trolley cars were put into service. Permission was gradually secured to introduce the trolley system and the mixed trolley and accumulator system on the lines of the company, so that now the company has 150 miles of track equipped electrically. On 21 miles of this accumulators are used, and the trolley system is used on the rest. When completed, the system will comprise about 295 miles of track. The current is supplied by local electric supply companies. The longest distance between the trolley lines on which accumulators have to be used is 3 miles, and the accumulators have not proved entirely satisfactory, as noticed repeatedly in the Digest. On account of the delays caused by the accumulator system, the authorities have authorized the temporary use of the trolley system where formerly it was prohibited.—*St. R'y Jour., Int. Ed.*, July.

Chicago & Milwaukee Railway.—A long and fully-illustrated article giving some notes on the operation of the power plant of this railway, which was one of the first to install in this country three-phase current distribution along its lines with rotary converters. There are also other notable features in the station, notably a novel system of connecting engines and generators in any desired combination. There are three generators, one a 250-kw, direct-current machine to supply the road in the immediate neighborhood of the station; the other two are of the same size, but 25-cycle, three-phase alternators. The arrangement of shafts and couplings is such that either engine can drive any generator or two generators, the rest for the time being shut down. Each of the two sub-stations contains two 125-kw rotary converters, and is provided with a storage battery.—*St. R'y Jour.*, July 7.

Hungarian Local Railways.—FISCHER and BRUNN.—An illustrated description of the Budapest and Budafok local railway, 6 miles in length. The Dickinson side trolley is used, with certain modifications, the trolley-wheel frame being made of aluminum bronze to secure lightness, and the two guides at each side of the trolley wire being dispensed with. The overhead switches and frogs, specially designed for this road, are illustrated. The road does considerable freight traffic, and has several locomotives, each equipped with two 25-hp motors. The standard scheduled speed is 24 miles per hour.—*St. R'y Jour., Int. Ed.*, July.

Surface-Contact System.—A description, illustrated by two diagrams, of an improved form of Merriman's rising contact stud. The contact stud, which in its normal position is below the level of the road, is flexibly connected to a weighted lever, which is actuated by a bell-crank lever attached to a continuous flexible strip, or treadle, which rests in the groove of the rail until it is wedged out by the flange of the car wheel as it passes. The lever then raises the contact stud. After the wheel has passed the weighted stud falls by gravity, thereby breaking the electrical contact and forcing the treadle back into its groove.—Lond. *Elec. Eng.*, June 29.

Wheels of Tram Cars.—A communication of the New York Car Wheel Works, calling attention to the need of heavier wheels, especially where heavier axles are used. Wheels 33 ins. in diameter and used with an axle 4 in. in diameter, should have a weight of not less than 400 lbs.—*St. R'y Jour.*, July 7.

REFERENCES.

Central London Railway.—The conclusion of the long, illustrated article, noticed in the Digest, June 23, 30, July 7, 14. The series-parallel system of control is described. In tests of a locomotive, coupled to 7 cars, the total weight of the train was 150 tons, includ-

ing the locomotive, which weighed 43 tons; the total distance covered was about half a mile, and the time 106 seconds; the observations made during the run are given in a diagram. The system of electric lifts, the signaling arrangements, and the lighting of the stations are also described.—Lond. *Elec. Rev.*, June 29.—A continuation of the well-illustrated article and a separate editorial referring to the opening ceremonies, in Lond. *Elec.*, June 29.

Ship Traction.—An article suggesting in a very general and popular way, to drive the merchants' ships on the rivers of France by electric motors supplied with current from storage batteries, and to erect along the rivers central stations in which the water power of the rivers is utilized to generate electric power for charging the batteries and for other purposes.—*L'Elec.*, June 16.

Calculation of Distributing Systems of Electric Traction under British Conditions.—SAYERS.—A reprint of his Brit. Inst. paper, noticed in the Digest, June 9, 16, 30, July 7, with an abstract of the discussion which followed.—*St. R'y Jour., Int. Ed.*, July.

Electric Traction in the House.—An illustrated translation of the German article on a trolley system for office purposes, noticed in the Digest, March 10.—*Sc. Amer. Sup.*, July 7.

Heavy Motor Vehicles for Common Roads.—HELE-SHAW.—A long abstract of the paper noticed in the Digest, July 14.—Lond. *Elec.*, June 29.

Automobiles.—WEBER.—A translation in abstract of the German article noticed in the Digest, June 9.—Lond. *Elec.*, June 29.

Interurban Electric Railway.—An illustrated description of the light-traffic trolley line between Detroit, Ypsilanti and Ann Arbor.—*Elec. Rev.*, July 4.

Third Rail.—A note stating that the B. & O. R'y Co. has decided to install a third-rail system in its tunnel at Baltimore. Four miles of double track will be thus equipped.—*St. R'y Jour.*, July 7.

Trolley System.—PRENTISS.—An illustrated description of the different types of moving contact, used with the overhead trolley system.—*Elec. Rev.*, June 27.

Railway Turntables.—PERKINS.—A brief, illustrated article on the electric operation of railway turntables.—*El'ty*, July 11.

Electric Heating of Street Cars.—A communication of the Gold Street Car Heating Co., denying the danger of fires from electric heaters. The best place for an electric heater in a street car is under the seats and set back into the panel board.—*St. R'y Jour.*, July 7.

INSTALLATIONS. SYSTEMS AND APPLIANCES.

Combined Lighting and Traction Plant.—KOLBEN.—A long, well-illustrated description of the high-tension, three-phase current municipal central station at Prag, Austria, furnishing electrical energy at the same time for tramways, power purposes and private and public lighting from the same set of machines and the same bus-bars. In the central station, three-phase currents at 3000 volts are generated, which are transmitted and partly transformed down to 123 volts for supplying private consumers for lighting and power purposes; partly converted into direct current at 500 to 600 volts for traction and public arc lighting; the central station has also two smaller dynamos generating direct current at 550 to 600 volts for supplying the tramways in the neighborhood of the station. The power plant is described in detail; it will have 5 steam-driven, three-phase generators, each of 750 to 1000 horse-power, and five others, each of 1500 to 2000 horse-power. Between the terminals of the machines and the switchboard, induction coils are inserted, in order to prevent too great a current rush in case that in paralleling machines there is no equality of phase, also in order to prevent surging. Tests made when the induction coils were not inserted, showed that troubles of this kind occurred, while with the induction coils inserted the installation works very well. The switchboards are described in detail. There are two sub-stations containing synchronous motor-generators for converting the three-phase current into direct current at 500 to 600 volts, and storage batteries. Finally he describes the distributing network.—*Elek. Zeit.*, June 28.

Maintenance of Motors on Hire from a Central Station.—PRUSSMAN.—A paper read before the Brit. Municipal Elec. Ass'n, in which he describes the experiment made in Bradford with the hiring out of motors. The motor itself seldom gives trouble of any description, provided it is chosen and fixed with due consideration to the nature of the work it is to perform, and that the starting arrangements are satisfactory. The starting switch is an item of vital importance, whose imperfections are often mistaken for the misdeeds of the motor. In Bradford, the majority of motors were to be used for hoist and crane purposes; first only shunt-wound motors were used, but later they were provided with compounding coils, the compounding winding being arranged to assist the shunt coils, which was a most marked improvement; he had great trouble with the starting device; first a form of starter was used, consisting essentially of two lead plates, falling by gravity into jars containing a dilute solution of sulphuric acid; the plates were operated by means of a rope or chain and the speed of the plates when descending was regulated by means of a dash-pot, containing glycerine, the plunger having an adjustable valve; a sudden heavy frost, and later a sudden thaw, brought these starters into a general disorder. He then tried different oils instead of glycerine in the dash-pots, but there were other drawbacks. Later he tried starters which had the form of a movable contact falling by gravity along a series of contact studs, which were connected to iron resistances; for some time the results were most satisfactory, but a slight sparking on the contacts soon commenced to bring about worse troubles than ever, although many types of contacts were tried, among them different forms of adjustable carbon contacts; he has not seen as yet a really reliable form of starting switch for his purpose. The size of motors used for hoist work ranged generally from 4 to 6 horse-power. For motors with a practically steady load throughout the day, generally shunt-wound motors were used; the best form of starting device was found to be a movement by means of worm and gear wheel, no automatic attachments of any kind being used; overload and automatic starters introduced troubles without effecting any advantage. Motors from ¼ to 3 horse-power gave more trouble by some 30 per cent than those ranging from 4 to 12 horse-power. Burning out of armatures or breaking down of field coils were very rare events. The enclosed motor has an enormous advantage over the open type, in view of the great risk there is of external injury to the latter; but the cost of maintenance of the open-type motors was found to be less than that of the enclosed, and for cool running they are superior to the enclosed motors. The foundations of the motors should be of a rigid and solid nature. He concludes that when properly organized and worked, a municipal motor-hiring department is not a scheme which need cost excessive sums for its maintenance in thorough working order.—Lond. *Elec. Eng.* and *Elec. Rev.*, June 29. The paper is discussed also in a separate article of the latter journal.

Gas-Driven Central Stations.—A long editorial. Reference is made to the article of Adams (Digest, May 12). In order that many large and desirable loads now operated in some cities by private lighting plants may be shifted to the public supply, it is necessary, not only that the rates of electric energy for light and power be lowered, but also that central stations distribute heat at a less cost to consumers than that at which they can produce it. To distribute the heat in exhaust steam, the central stations must be situated in the centre of population, and should be equipped with gas engines (see the following abstract of the article of Adams); the plant producing the gas for their operation may be located many miles away, the gas being transmitted through pipes to the electric stations. Reference is made to a paper, read by Lewes before the Inc. Inst. of Gas Engineers of London, describing the Dellwik-Fleischer system of producing water gas. Dellwik water gas is said to be one of the cheapest fuels for producing power by means of gas engines; with coke at $2.16 per ton, the gas costs only about 6 cents per 1000 cu. ft.; as a British gas engine firm guarantees a consumption of 30.5 cu. ft. of this water gas per hp-hour, the cost per hp-hour comes out at 0.2 cent for fuel.—*Jour. of Elec.*, June; the paper of Lewes is reprinted in abstract in the same issue, and also in *Prog. Age*, July 2.

Utilizing the Waste Heat from the Gas Engine.—ADAMS.—An article stating that the efficiency and losses may be fairly assumed as follows for gas engines of moderate capacity: efficiency 18 per cent, losses by conduction and radiation 5 per cent, heat escaping in exhaust gases 37 per cent, and in the jacket water 40 per cent. He suggests to utilize the latter quantities of heat for a hot-water heating system, by passing the jacket water after leaving the engine, through pipes subject to the action of the exhaust gases; leaving the gas-heated pipes, the hot water supply should go to the radiators or other heating surface, and thence back to the water jacket on the engine cylinder. He gives some figures on the economy of such a system.—*Eng. Mag.*, July.

Spanish Central Station.—An illustrated description of the new electric station of Granada. Water power is used, the plant being situated 6 miles from the city. It is designed for 5 sets, each of 350 horse-power; at present only three are installed. The turbines are of the horizontal shaft type, and are direct coupled to alternators,

giving 54 amperes at 4200 volts, the frequency being 52.5. There are at present 12 transformer stations, and the distribution is on the three-wire system, with 125 volts on each side. The installation was made by Swiss firms.—*Revista de Obras Pub.*, 1899, p. 87; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 140, pt. 2.

REFERENCES.

Means of Stimulating the Demand for Electric Supply.—An article discussing and criticizing the papers of Potter and Bishop (Digest, July 14); also an abstract of the discussion which followed these papers.—Lond. *Elec. Rev.*, June 29. An abstract of Potter's paper and of the discussion also in *Lightning*, June 28; an abstract of the discussion also in Lond. *Elec.*, June 29.

Units for Central Stations.—Two communications discussing the general principles that should guide in the selection of units for a central station.—Lond. *Elec. Eng.*, June 29.

Lighting fo Small Towns.—HARRIS.—A reprint of the paper in abstract, noticed in the Digest, July 14.—*El'ty*, July 11.

Heating from Central Stations.—YARVAN.—A paper read before the Am. Soc. of Mech. Eng. on hot water heating from a central station.—*Prog. Age*, July 2; *El'ty*, July 11.

WIRES, WIRING AND CONDUITS.

REFERENCES.

Aluminum Conductors.—An editorial referring to extensions of the plant of the Pittsburg Reduction Co., and to several instances of the use of aluminum wire for power transmission in the Uinted States. Copper and aluminum are compared as to the conductivity, weight and tensile strength. Alloying aluminum with a small percentage of foreign metal increases the tensile strength, but diminishes the conductivity. Nothing new appears to be given.—Lond. *Elec. Rev.*, June 29.

ELECTRO-PHYSICS AND MAGNETISM.

Production of Cathode Rays by Ultra-Violet Light.—LENARD.—A paper in which he proves that the discharge of electrified bodies by ultra-violet light is due to the production of cathode rays by the impact of the light. The theory hitherto accepted that the discharge is due to the mechanical disintegration of the electrode is rendered invalid by the fact that this would require the transfer of an amount of material such as could not fail to be detected by the spectroscope, and the spectroscope does not make any such indication. The constant increase of the discharge with the exhaustion, as well as the strictly one-sided character of the discharge, suggested the probability of cathode rays being concerned in it, which was proved by the following experiment: A vacuum tube was furnished with two electrodes, and exhausted until it failed to allow any discharge to pass; one of the electrodes was exposed to the ultra-violet light furnished by a spark-gap with zinc terminals; when the electrode was charged negatively, it was instantly discharged by the ultra-violet light; a positive charge, on the other hand, was retained indefinitely. The potential is of no account, except that the discharge is not so complete at low potentials, probably on account of a lack of energy of the cathode rays. That the cathode rays are really in question, is shown by the rectilinear propagation of the discharge and by its magnetic deflection. The ratio of charge to mass comes out as high at 0.0000115, and the velocity as low as 1-30th of the velocity of light. The rays are not sufficiently intense to produce phosphorescence of the walls of the tube. But it is now possible to produce these rays in an "absolute" vacuum, and with any given difference of potential.—*Ann. der Physik*, No. 6; abstracted in Lond. *Elec.*, June 29.

Some editorial notes, referring to this paper, and pointing out that, like Lenard's former discovery, which led to the discovery of the Röntgen rays, the present one is "not such as would appeal to the man in the street; but to the electrician its significance is of the greatest moment." It sheds a flood of light on a number of photo-electric phenomena which have hitherto been obscure. While he does not seem to have made any experiments with polarized light, such experiments are called for by Elster and Geitel's work. The precise mechanism by which a beam of light is enabled to ionize a charged metal not immersed in a gaseous medium will form a fascinating subject of research. Such an electrified body gives out cathode rays which at ordinary pressures will be absorbed by the surrounding air and will, in turn, make that air conducting. This explains the influence of ultra-violet light in lowering the spark potential. Not only is the production of cathode rays now independent of the pressure of gas; it is also independent of the potential of the cathode, so long as that is negative. This would appear to place at our disposal a new form of "current valve," simpler and more reliable than the aluminum cell.—Lond. *Elec.*, June 29.

Alternating-Current Sparking.—KALLIR.—An account of experiments in which he photographed on a rotating photographic plate the sparks produced between metals by breaking an alternating-current circuit at various phases. The duration and intensity of each spark depend upon a number of circumstances, such as the shape of the terminals in contact, the facility of evaporation of the material, the speed with which the terminals are separated, and the phase at which the interruption takes place. The spark is confined to one semi-period, *i. e.*, there is no alternating spark. In ordinary air, the spark never exceeds one semi-period in duration; but in a vacuum, especially with strong currents, the duration of the spark may well exceed an ordinary commercial semi-period; even then, however, the spark is intermittent and is confined to the odd or the even semi-periods.—*Ann. der Physik*, No. 6; abstracted in Lond. *Elec.*, June 29.

Röntgen Rays.—ROLLINS.—A continuation of his long serial. He regards the ether between the terminals of a Röntgen ray tube as polarized and partly dissociated. There are "lines of swung ether units between the terminals, and free ether particles of electricity at each terminal; as we increase the energy applied to the tube, there comes a time when the dissociated ether collected about the gas particles in the terminals, tears them off and rushes them across the field, causing them to strike the opposite terminal with such force as to raise them to such a high temperature that they become centres from which X-light originates." Both terminals yield Röntgen rays, but for practical purposes the anode does so, because "in the process of preparing a good X-light tube the gas is removed more rapidly from the anode than from the cathode."—*Elec. Rev.*, June 27.

Thermoelectricity.—ABT.—An account of a systematical investigation of the thermoelectric forces of combinations of pyrite, pyrolicsite, pyrrhotite, chalcopyrite, etc., between the temperatures of 0 and 100 degs. Taking the e. m. f. developed by a bismuth-antimony couple between these temperatures as a unit, that of a pyrite-chalcopyrite couple is 10.8, and that of a pyrite-galena couple 13.4.—*Ann. der Physik*, No. 6; abstracted in Lond. *Elec.*, June 29.

REFERENCES.

Corpuscular Dissociation.—J. J. THOMSON.—An article, giving "some speculations as to the part played by corpuscles in physical phenomena." He gives a brief outline of his theory of corpuscular dissociation (Digest, Oct. 14, Nov. 25, Dec. 30, Apr. 7), according to which some of he molecules of the substance are continually breaking up by the detachment of a corpuscle, and are being re-formed by the arrival of another corpuscle, so that at each instant there are a certain number of free corpuscles with negative charges distributed throughout the body, while the corresponding positive charges are on the molecules of the body; the corpuscles are much more mobile than the molecules, and in solids and liquids the latter may be regarded as almost fixed in comparison with the former. He develops briefly some consequences of the theory, if the corpuscles are acted upon by gravity or by a magnetic field, or by an electric field. He discusses briefly the effect discovered by Ettinghausen and Nernst, the Hall effect and the Thomson effect.—*Nature*; reprinted in *Elec. Rev.*, June 27.

Volta Effect.—An article referring to Lodge's paper (Digest, Mar. 17, Apr. 28, June 23), and giving a brief outline of the controversy concerning Volta's contact force. It is said that Lodge's view of the phenomenon probably is now generally taken, except by Lord Kelvin. The concluding chapter of Lodge's paper is reprinted.—Lond. *Elec. Rev.*, June 29.

Coherer.—MALAGOLI.—An account of an experimental investigation of the mechanism of the action of the coherer.—*Il Nuovo Cim.*, October, '99; abstracted in *L'Eclairage Elec.*, May 19.

Radium Radiation at Low Temperatures.—BEHRENDSEN.—An account of an investigation of the influence of the temperatures upon the activity of radium. It is considerably decreased by intense cold. On restoring the ordinary temperature the activity was increased, but this increase was transient.—*Ann. der Physik*, No. 6; abstracted in Lond. *Elec.*, June 29.

Ionized Air.—PETTINELLI.—An account of an experimental investigation of some thermical properties of air ionized by a spark discharge.—*Il Nuovo Cimento*, August, '99; abstracted in *L'Eclairage Elec.*, May 19.

Zeeman Effect.—VOIGT.—A theory, based upon the formulas of

Hertz and Drude for the electromagnetic dispersion, and giving an account of the dissymmetries in Zeeman's normal triplets.—*Ann. der Physik,* February; abstracted in *L'Eclairage Elec.,* May 26.

Zeeman Effect.—ZEEMAN.—A long, French abstract of the paper noticed in the Digest, Mar. 24.—*L'Eclairage Elec.,* May 26.

Sun's Corona.—CANTOR.—From experiments which he has made, he concludes that a rarefied gas through which an electrified discharge is passing, shows no perceptible absorption corresponding to its emission spectrum.—*Ann. der Physik,* March.

FITZGERALD.—He says that Cantor's observation confirms the suggestion that the sun's corona is an electrical discharge around the sun, since the bright spectrum lines of the corona are not represented by a dark line in the solar spectrum.—*Nature,* May 3.

PRINGSHEIM.—A severe criticism of Cantor's experiments which, he says, have not been made with suitable precautions.—*Ann. der Physik,* No. 5; these three papers are briefly noticed in *Am. Jour. of Sc.,* July.

ELECTROCHEMISTRY AND BATTERIES.

Charging Storage Batteries at Constant Voltage.—HEIM.—Continuation and conclusion of the very long serial, noticed in the Digest, May 19, June 30. The main results of his tests are given in a table. It appears, for instance, that storage batteries, when charged for 1½ hours at constant pressure of 2.5 volts, were charged about to the same degree as when charged for 3½ to 4 hours with constant current. At the beginning of a charge at constant voltage the current first decreases rapidly, increases then slowly, and decreases then continually. If a number of charges at constant voltage and discharges are made, without stops between the charges and discharges, the maximum and the average charging current and the capacity increase from charge to charge, first quickly, later more slowly; the reason seems to be, that the cells are heated up, so that the internal resistance decreases. If in continual operation, a storage battery is charged at constant voltage several times daily, but not up to full charge, and if the battery rests during the night, the average capacity gradually decreases, the probable reason of which is said to be the increasing formation of white 'inactive" sulphate of lead; in order to keep the capacity constant, it is necessary to charge the battery some times up to full charge, *i. e.,* to vivid development of gases, for instance, every day once, at the end of the day's work. Short charges at constant pressure of 2.4 or 2.5 volts hurt the electrodes more than charges of 3½ to 4 hours with constant current and with a relatively smaller current density. The excessively high current density at the beginning of a charge at constant voltage hurts the contact between the active material and the solid lead, so that continually, especially at the positive plates, the active material falls off. He found that the falling off of the peroxide from the positive plates decreased with every new charge; by 70 charges at constant voltage and many enforced discharges, the capacity was diminished by 5 to 6 per cent; he concludes that hundreds more of such charges would decrease the capacity only slowly. In the practical use on tramway cars, the wear and tear of the plates is much greater than in the laboratory tests, which is caused by the mechanical shocks. The method of charging a battery at constant voltage may be used only, when a short time is available for charging, as for traction purposes. It is also easier and cheaper to charge a storage battery, used for lighting a railway car, in 15 or 30 minutes at constant pressure, which is sufficient for that purpose, instead of replacing it by another battery. Also in lighting plants this method of charging may be used under certain circumstances; if, for instance, after the maximum load of the day is over, the battery is nearly discharged, it may be charged in a short time at constant voltage, for the night and morning load. But in lighting plants, charges at constant voltage may be used only exceptionally, and in general the charging current should not be more than is usual; in exceptional cases, however, the charging at constant pressure should be used, as there is no danger for the life of the battery, if the voltage is not over about 2.4 volts. He believes that the number of cases in which the method of charging at constant voltage can be used, may increase continually, and this the more, the more it will become custom to regard the plates of the storage battery not as instruments or apparatus, but as an article of consumption which must necessarily be often exchanged.—*Elek. Zeit.,* June 7, 14, 21.

REFERENCES.

Electro-Chemistry.—PERKIN.—An illustrated article on the advancement of electrical chemistry. The practical applications of the powerful oxidizing action of ozone are briefly noticed. An experiment of Majorana is described, which shows that the influence of high pressure and high temperature combined is sufficient to convert amorphous carbon into the crystalline variety. Reference is made to the development of the carborundum and of the alkali and bleaching industries, and to the preparation of printers' colors by electrolysis. Some instances are mentioned of the use of electric methods in organic chemistry.—*Nature*; reprinted in *Elec. Rev.,* July 4.

Majert Storage Battery.—An illustrated article on this battery, described in the Digest, Dec. 2, which is manufactured in France by the Union Co.—*L'Elec.,* June 23.

Electrolytic Preparation of Fluorine.—MOISSAN.—A translation of the French paper abstracted in the Digest, Aug. 5, 1899.—*Sc. Amer. Sup.,* July 7.

UNITS, MEASUREMENTS AND INSTRUMENTS.

Photometer.—MARTENS.—An illustrated description of a photometer for measuring a given light against a standard, both on a long optical bench. Both sources of light are made to illuminate two openings of a tube through two reflecting prisms and a piece of milk glass, the tube being perpendicular to the direction of the photometer bench and placed between the two sources of light. The rays of light then pass through a lens, a bi-prism, and a hole in the centre of the end plane of the tube. Each half of the bi-prism yields an image of each opening in the end plane of the tube; but the hole in its centre allows only one image of each opening to come through; the eye, looking through, sees the one-half of the bi-prism illuminated by the one source of light, the other half of the bi-prism by the other source of light; and on adjusting the relative position of the sources of light to the tube, the two fields come to be equally lighted up, and then the line of separation between the two halves of the bi-prism becomes completely invisible when the midriff, separating the two openings of the tube is slipped out of the way. This arrangement satisfies the requirement that each field shall be quite free from stray light derived from the opposite source. Three modifications of the instrument, increasing the brightness and introducing the principle of contrast, are also described and illustrated. The advantages of the instrument are said to consist in its sensitiveness and its cheapness. It is pointed out that the bi-prism is capable of rendering great service in photometry.—*Jour fuer Gasbel.,* March 31; translated in abstract in the *Gas World,* Apr. 14; *Prog. Age,* June 15.

REFERENCE.

Clark and Weston Cells.—MAREK.—A table of the values of the e. m. fs. of these two cells between 0 and 30 degs. Celsius.—*Ann. der Physik,* March; noticed in *L'Eclairage Elec.,* May 19.

TELEGRAPHY, TELEPHONY AND SIGNALS.

Electric Tramways and Submarine Cables.—SCHAEFER.—An illustrated communication referring to Jamieson's paper (Digest, Mar. 31, Apr. 14, 21, June 30). He says that Jamieson's conclusion as to the nature of the disturbances being electromagnetic is an extremely doubtful one. He thinks the disturbing effects are electrostatic in character. In the case of an ordinary armored or lead-sheathed cable, having the conductor of its core completely insulated, the difference of potential due to the stray external current has the effect of simultaneously disturbing the normal electrostatic charges on the copper conductor within the dielectric; this results in a redistribution of charges with every variation of the external potentials, and consequently is responsible for internal surgings of charge which sympathetically affect the receiving condensers. He concludes that perfect compensation can alone be secured by means of a twin core cable which should be laid out well beyond the limits of the affected district. —Lond. *Elec.,* June 29.

REFERENCES.

Interception of Wireless Telegrams.—TOMMASI.—A translation of the French article abstracted in the Digest, July 7.—*El'ty,* July 11.

Telephone Transmitters and Receivers.—MONTILLOT.—An illustrated article on the Burgunder system of telephone transmitters and receivers.—*L'Elec.,* June 23.

Long-Distance Telephony.—An illustrated article on Pupin's patents for the "art of reducing attenuation of electrical waves and apparatus therefore."—*Elec. Rev.,* July 4.

MISCELLANEOUS.

China.—CHILD.—An article on the opportunity for American export trade in China. Since the close of the Japan-China war the interior of China is being rapidly developed. Several large cities in the prov-

inces of Hupeh and Hunan, Shanghai, and other coast cities, also the large Russian tea hongs in Hankow, the cotton mills and silk factory at Wuchang, and the iron works at Honyon, are lighted electrically. Also telephone exchanges are being established.—*Elec. Rev.*, June 27.

REFERENCES.

British Municipal Electrical Association.—An account of the proceedings of the fifth annual convention. Some of the papers read there are abstracted in the Digest, July 14, and in this week's Digest.—Lond. *Elec., Elec. Rev., Elec. Eng.*, June 22, 29; *Lightning*, June 28.

Electromagnet for Oculists.—ALIAMET.—An illustrated description of an electromagnet for removing small pieces of iron from eyes.—*L'Elec.*, June 23.

United States in 1899.—DELMAS.—An article on the development of electrical engineering in the United States in 1899, dealing with the New York elevated railroads, the Boston tramways, the double scale of charges for power at different hours, established in Brooklyn, the use of electricity for heating tram cars, and the developments at Niagara.—*Mem. de la Soc. des Ing. Civ. de France*, November; abstracted in *Brit. Inst. Civ. Eng. Abstracts*, v. 140, pt. 2.

Electricity and Engineering.—PREECE.—A reprint of his lecture on the relations between electricity and engineering, noticed in the Digest, May 19.—*Jour. of Elec.*, June; an abstract of the lecture in *Elec. Rev.*, June 27.

New Books.

GAS ENGINE DESIGN. By E. J. Stoddard. Detroit, Mich.: Parker & Burton. Quarto pamphlet, 32 pages, 14 illustrations.

This pamphlet gives a method of gas engine design based, it is stated, upon formulas deduced by the author from theoretical considerations. Practical shop rules are given for proportioning parts, the author stating that they are the result of six or eight years' experience in that line of work. The portion of the book dealing with general considerations is somewhat sketchy, the reader being frequently referred to other works for fuller information. The final chapter, however, gives formulas directly applicable for proportioning the various parts of a gas engine.

CRAFT'S TABLES OF PLATE AND RIVET VALUES. Cleveland, Ohio: Thomas H. Craft. Price, $1.00.

These tables are intended for boiler designers and makers, inspectors and engineers, to assist in designing and calculating the efficiency of boiler joints. The larger of the two tables gives the plate values (net sections) at 60,000 lbs. per square inch for net lengths of from 1 in. to 4½ ins., by thirty-seconds; and for thickness from ¼ in. to 1⅜ in., by thirty-seconds or sixteenths. The other table is for rivet values in pounds per square inch, single and double shear, for rivets from ½ in. to 1⅜ in., and 38,000 to 44,000 lbs.

THE COMPOUND ENGINE. A Series of Lectures by F. R. Low. New York: The Power Publishing Company. 52 pages, 37 illustrations. Price, 50 cents.

This pamphlet, consisting of 52 pages, is 5¼ ins. by 9 ins., flexibly bound, contains about all the information necessary to enable an engineer to become familiar with the operations which take place in the cylinders and receiver of a compound engine. A good deal of attention is given to the indicator work on this class of engines, and the theory of expansion is plainly set forth together with the adaptation of two cylinder engines to obtain the best results from expansion. With this book, the engineer who suddenly has a compound placed in his care, will have no difficulty in mastering the things he should know in order to care intelligently therefor. The student of steam engineering will also find therein considerable information of value.

TRACTION ÉLECTRIQUE. Extrait des Leçons Professées a l'Institut electrotechnique Montefiore. Par Eric Gerard, Paris: Gauthier-Villars. 136 pages, 92 illustrations. Price, 3.50 francs

This brochure is a reprint of the electric railway section of Prof. Gerard's last (fifth) edition of Lecons sur l' Eléctricité. Like everything that proceeds from the pen of this author, the exposition is extremely lucid and the development logical. The greater portion of the book is descriptive, and refers largely to American tractions. In a chapter on the design of electric railway systems, and in another on the cost of electrical traction, are contained considerable data of interest not otherwise to be found except in scattered sources.

BOOKS RECEIVED.

PHOTOMETRIC MEASUREMENTS. A Manual for the General Practice of Photometry, with Especial Reference to the Photometry of Arc and Incandescent Lamps. By Wilbur M. Stine, Ph.D. New York: The Macmillan Company. 270 pages, 67 illustrations. Price, $1.60.

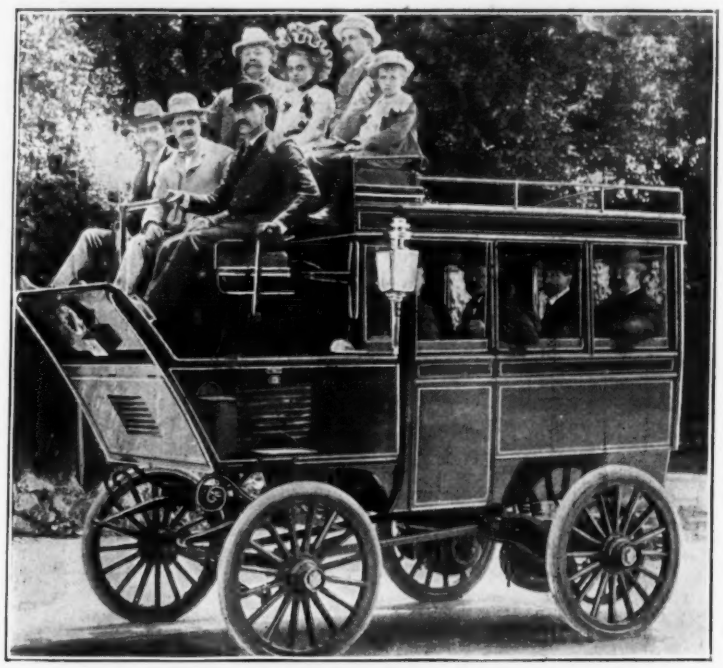
HANDBUCH DER ELEKTROTECHNIK. Vierter band. Ein-und Mehrphasen Wechelstrom-Erzeuger. By Dr. Fritz Niethammer. Leipzig: Verlag von S. Hirzel. 328 pages, 656 illustrations. Price, 18 marks.

THE ELECTROMAGNET. Edited by Townsend Wolcott. With Part II. by Richard Varley. Jersey City, N. J.: The Varley Duplex Magnet Company. 57 pages, 15 illustrations and chart. Price, 50 cents.

GAS ENGINE CONSTRUCTION. A Practical Treatise Describing the Theory and Principles of the Action of Gas Engines of Various Types, and the design and Construction of a Half Horse-Power Gas Engine. By Henry V. A. Parsell, Jr., and Arthur J. Wood. New York: Norman W. Henley & Company. 296 pages, 140 illustrations. Price, $2.50.

The Lindstrom Electric Omnibus.

In our issue last week attention was directed to various types of Lindstrom electric automobiles now being put on the market by the Hewitt-Lindstrom Motor Company, of Chicago. Herewith is illustrated the omnibus now being built by the concern, in regard to which it was stated that at an output of 120 volts and 125 amperes, a speed of 9 miles an hour has been made. The amperage in this case should obviously have been given as only 25 amp. The omnibus,



ELECTRIC OMNIBUS.

which will seat 18 to 20 persons, weighs 5400 pounds and has two 4½-hp motors, which will stand, if necessary, an overload of 100 per cent. The battery has a capacity of 19 kw and gives the omnibus a radius of 56 miles on one charge. The steering and control levers are handily placed, as will be seen, and the omnibus is equipped with electric lights, bell, etc. In the Lindstrom automobiles the brake is enclosed with the motors, but in such large vehicles as the omnibus, an emergency brake is used, which acts against the outer surface of an internal gear.

Boston to Newport on One Charge of Battery.

It is interesting to note that during the past year a good deal of progress has been made towards the development of a storage battery capable of furnishing mileages on single charges two or three times greater than obtained previously. The electric automobile promises to become as reliable and convenient a conveyance for ordinary runs between cities and towns and throughout the country as it now is for service usually confined to the limits of cities.

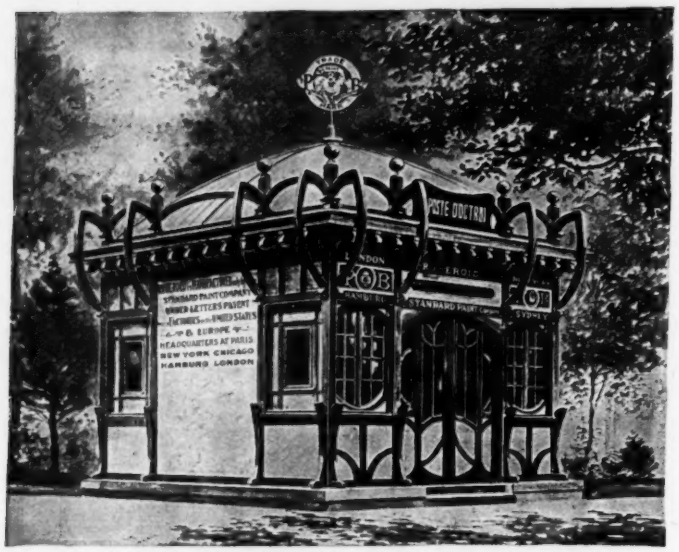
This month one of the Electric Vehicle Company's carriages was

run on one charge of the battery, from Boston to Newport, over roads which made the distance 72½ miles. The total time consumed, including stops, was five hours and eighten minutes, and the average speed was over 14 miles per hour. The vehicle used was not designed for speed, and it was not attempted to make it. This run, however, with the other long runs recently made by electric vehicles, certainly indicates that the storage battery carriage is not only the ideal automobile from the point of view of simplicity and convenience, but is also being rapidly developed into a vehicle which can be used for any ordinary touring, or for runs of under 100 miles on a single charge of the batteries.

The "P & B" Paris Exhibits.

Among the most novel of the American exhibits at the Exposition is a pavilion erected by the Standard Paint Company, of New York. It is unique in construction and in its location at the Avenue d'Jena entrance. The inscription "Standard Paint Company," the American and European trade-marks and the various head offices—New York, London, Paris, Hamburg, Berlin and Sydney—appear on the front of the pavilion; while, surmounting the roof as a weather-vane, is the well-known "P & B" with the rooster trade-mark in gold. The trade-mark seems peculiarly fitting in a place so entirely Gallic in character, as the building itself is occupied by the officers of the Paris Customs, which is indicated by the legend "Poste d'Octroi."

By special concession, after the French architects had themselves



PAVILION OF STANDARD PAINT COMPANY.

made successful use of P & B Ruberoid in the hallways and on the stairways of the chief operating building of the Exposition Commissioners at 2 Avenue Rapp for more than a year before the Exposition opened, it was arranged that an ornamental pavilion, to be constructed inside and out, flooring, sides, ceiling and roof, of Ruberoid, should be erected for the use of the French authorities in the colonial section. Thus, a building purely American in material is being actually used during the term of the Exposition by the French Government. It is classified in the section of architecture.

Ruberoid, which has been so largely used as a roofing all over the United States, in nearly every European country, in Australia, Africa and parts of Asia, is shown in the Paris pavilion, capable of the highest art decoration. The Ruberoid covering the exterior walls is decorated in imitation of gray birch with pilasters in oak. The roof is Ruberoid undecorated. The interior walls, above the base of imitation wood, are tastefully painted in floral designs on a delicate background, as in fresco. The ceiling is paneled and the Ruberoid elaborately decorated in allegorical design, emblematic of the American, European, Asiatic and African continents. The flooring bears a tastefully-colored border in Grecian design.

Though Ruberoid was in service as a decorated flooring at the recent Brussels, Sydney and other expositions, the Paris decorations are of a higher artistic grade than has heretofore been attempted; and, as floors covered with Ruberoid have shown a lasting quality of over five years, here would seem to be a material that will ere long prove a formidable rival to oil and other floor cloths, having the further merit of being far below such in cost. While other flooring manufacturers were paying high prices for the privilege of laying their material in various parts of the Exposition, many solicited Ruberoid for their floors. The roofs of the Exposition warehouses in the Rue Javelle are also covered with Ruberoid, and thus this American product has on its special merits won the highest place, where the barriers of tariffs, natural trade prejudices and the world's competition were all encountered.

In the American section (Machinery and Electricity Department) the P & B electrical compounds, insulating varnish and tape are shown; in the Civil Engineering and Transportation Department are the well-known P & B insulating papers, roofing and other products of the Standard Paint Company. The photograph shown in the engraving gives a very clear idea of the pavilion which typifies a material, the use of which in the past ten years has spread from its native New York and New Jersey to the DeBeers mines, South Africa, to the German settlement at Kiautchau, China, and every portion of the civilized earth.

The chief offices of the company in Europe are at 50 Boulevard Haussmann, Paris; 59 City Road, London, E. C., both of these offices being in charge of Robert W. Blackwell & Co., Ltd.; at 16 Friederich Strasse, Berlin, and 33 Grimm, Hamburg, the German offices being in charge of Allut Noodt & Meyer Co., Ltd. American visitors to the Exposition are heartily welcomed at these offices, and every possible courtesy is extended to them.

The Pansignal.

The ingenious signaling device which is the subject of this article, is intended for use as a hotel call, fire alarm, or in any other position where a series of numbers is needed and absolute reliability is indispensable. The form herewith described is intended for hotel use, and the apparatus as seen by the guest in his room is illustrated in Fig. 1. This signal transmitter has a large range of action, notwithstanding its simplicity, the one shown being capable of sending 499 orders, indicating the number of persons to be served up to six. The orders are designated by a number, a book placed conveniently at hand supplying the guest with a most extensive list of necessities and luxuries. In fact, to one who has given the subject but little attention, it is quite surprising to see the variety of wishes which can be gratified within the limits set.

The apparatus is shown in detail in Figs. 3 and 4. It consists of a rotating arm, *A*, moving over insulated semi-circles, *C*, *C*, provided with raised contact points, or terminals, arranged in groups. This carrier is driven by a train of clockwork actuated by the spiral spring. To "set" the instrument, the handle is turned down, thus extending the spring, and is held in this position by a magnetic catch, operated by the magnet, *M*, until released by the office clerk, as hereafter described. In the wall instrument, shown with the face removed in Fig. 2, the handle is replaced by a lever, to the end of which the chain and pendant are attached.

In the upper semi-circle there are, in the instrument shown, two groups of contact points, nine in each group, suitably spaced. These represent tens and units. In the lower semi-circle are groups representing the room number, then a space, then a group of four representing hundreds, then a space and a group representing the number of persons to be served. Current being supplied to the carrier, it will be seen that, as it rotates, as many electrical impulses will be sent over the wire attached to each semi-circle as there are contact points in the path of the brushes. If the circuit be maintained unbroken between carrier and brushes, the upper brush transmits nine impulses, followed after a brief interval by nine; and the lower brush simultaneously transmits electrical impulses representing the room number, then after an interval, four impulses representing hundreds, then six impulses representing the number of portions desired.

To vary these signals, the inventor resorts to a simple expedient. In the electrical path leading from the carrier to each brush is a circuit-controller operated by a tumbler block, S, S, attached by a steel pin on which it turns. The outside plate of the instrument is provided with pins, *P*, *P*, permanently lying in the path of the tumbler block on one side, and with rows of numbered holes in which pins, *Q* *Q*, may be inserted in the path of the tumbler block on the other side. The permanent pins thus act to force the tumbler blocks to close the circuit between the carrier and the brush just before the latter reaches

a group of contact points. The displaceable pins, *Q*, *Q*, act to force it to break the circuit between the carrier and brush after the latter has passed over the contact point corresponding to the number of the hole in which the pin has been inserted. The carrier revolves always in the same direction, making one-half a revolution for each signal.

A diagram of a single circuit is shown in Fig. 5. In the figure, *D*, represents the annunciator drop in the hotel office, and *J* a plug switch which is one of a series placed under the annunciator and stamped with the various room numbers. Normally, the plug is in the opposite side of the switch to that shown. When the Pansignal in the guest's room is "set," it is brought to the position shown, and held there by the magnetic catch mentioned above. By suitable contacts within the case, this completes the circuit through the annunciator, causing *D* to drop and attracting the clerk's attention. The plug, *J*, is then transferred to the position shown in the figure and the switch *K*, closed. This energizes the magnet, *M*, releases the carrier, and starts the

FIG. 1.

FIG. 2.

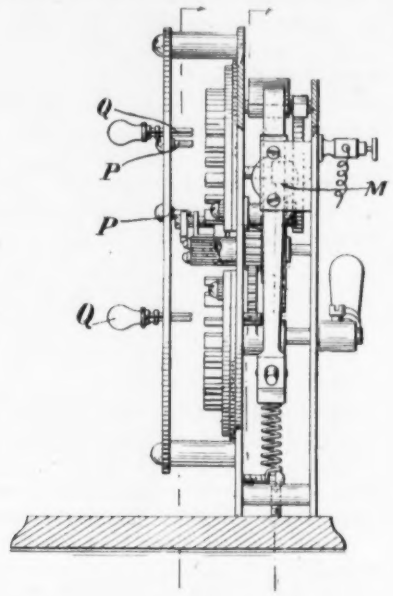


FIG. 3.

signaling apparatus in motion. The signals or interruptions from one arm of the carrier are recorded directly by the register, *T*; those from the other arm are recorded by the register, *U*, in the local circuit of

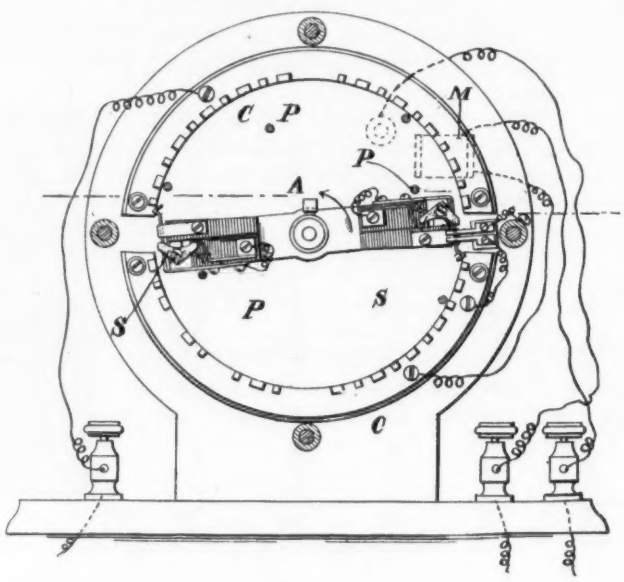


FIG. 4.

the relay, *R*. The recording instrument used is the double-pen Morse register—one pen recording tens and units in black, the other recording portions, hundreds and the room number in red.

To illustrate: Suppose it is desirable to transmit the order represented by 463 and for 6 persons. Pins are inserted in the hundred row at 4, the tens row at 6, the units row at 3, and the "service" row at 6. The handle is then pulled, setting the signal.

When the automatic receiver in the office releases the magnet and the carrier rotates, the following action takes place: The tumbler block on the end of the carrier moving over the upper semi-circle is already in closed-circuit position, and the brush it controls therefore supplies current to three contact points in succession as it passes over them, sending three electrical impulses over the wire leading from that semi-circle. The tumbler block then encounters the pin set in hole 3 of the "units" row, and at once breaks the circuit between the carrier and the brush, so that no more impulses can be sent. When, however, the tumbler block reaches the end of the "units" row, it encounters the permanent pin on the other side, and again closes the circuit between the carrier and the brush, which now proceeds to send six electrical impulses over the same wire, by way of the contact points in the "tens" group, till the tumbler block reaches the pin inserted in hole 6 of that row, when it again breaks the circuit.

Simultaneously, the brush and tumbler-block circuit-controller on the other end of the carrier have been doing similar work on the lower semi-circle and its groups of contacts, transmitting first the room number, then the hundreds, then the number of persons for whom service is desired.

A notable feature of the tumbler-block circuit-controller is its breadth of movement. In the instrument photographed for this article, it breaks by one-half inch air-gap, and has a rubbing contact of one-half inch in making. Its action is, therefore, positive and reliable.

If more than one signal be sent in at once, the clerk will receive them separately, as no connection is made with the register until the plug, *J*, is transferred, and after the Pansignal is set it can be released only from the office. A time stamp is attached to the recorder, and registers the time of the order. If desired, two or more registers may be used, one of the extra ones being placed in the steward's room, one in the wine room, etc. The use of a recorder in connection with a signaling device of this description is of particular importance, especially in hotel use, since an exact record is automatically kept of everything which is ordered by the occupant of a room. In case of a dispute, therefore, as to any order, the original record tape of the instrument can be produced.

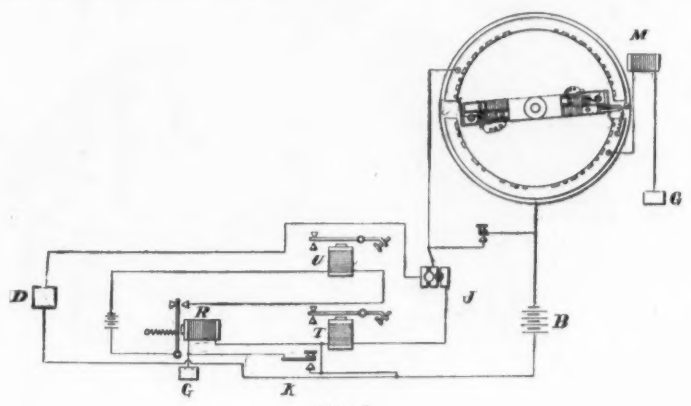


FIG. 5.

If the Pansignal is being installed in a hotel which has been using

some other system, the old annunciator will evidently be perfectly serviceable. In cases, however, where new apparatus throughout is being provided, the lamp annunciator made by the same company is more desirable. This is similar to the lamp switchboards used by telephone exchanges, and when operated with the Pansignal, the lamp remains lighted until the plug, *J*, is removed from its normal position. The mere receiving of the signal thus automatically puts out the light and saves the operator the trouble of resetting his annunciator.

It will readily be seen that the action of the Pansignal can be varied to suit many purposes. By using a lower semi-circle cut like the upper, for example, the instrument shown may be made to transmit any one of 9999 signals. In its present form it transmits $500 \times 6 = 3000$. By having three groups of terminals in each semi-circle its efficiency is increased to 999,999 signals.

The Pansignal employs only one direct wire to the receiver. The other two are trunk lines to which all the instruments are coupled in multiple, or, as shown, one connection may be to ground, and only one trunk line required. Many minor details, such as means for suppressing the spark between brush and terminals, and enforcing absolute non-interference between signals, are provided in a way to secure the result desired.

The entire system is covered by patents lately issued to Henry Guy Carleton, assignor to the Carleton Electric Company, New York, which is manufacturing the Pansignal.

A New Type of Theatre Dimmer.

The conditions encountered in the installation of theatre dimmers demand such a variety of types, and so many different arrangements and combinations, as to make nearly every installation a special job, requiring work different in some respects from standard. This not only increases the expense, but occasions delay and uncertainty in filling orders, besides making the work more or less experimental.

These considerations have led the Wirt Electric Company, Philadelphia, to design a type of dimmer permitting flexibility in installing, while still maintaining a standard of construction. The further advantages claimed are ease of operation and compactness.

When demanded, the dimmer proper may be placed below the stage floor, or on a bracket high above the floor, the interlocking mechanism only being on the switchboard. By this arrangement space is economized to such an extent as to have all levers and interlocking parts on a very small panel. For example, a bank of 25 dimmers may be controlled on a board 2 feet square, and occupying a depth of but 6 inches.

A cam permanently attached to the interlocking shaft near the loose sheave engages with the spring plug attached to the short lever, when the handle is given a quarter-turn. With this arrangement any desired dimmer may be picked up by the master lever in whatever position it happens to be, and any or all of the dimmers operated simultaneously.

Another cut shows a plan of a dimmer board, upon which are mounted 24 3-wire Wirt universal dimmers. The plan shown here is one best suited to the conditions usually met with. A third illustration represents a dimmer recently shipped to one of the large western cities.

The dimmers are arranged in three banks on three interlocking shafts. The top bank for control of the white lights has dimmers for five border circuits, the proscenium arch, the footlights and the

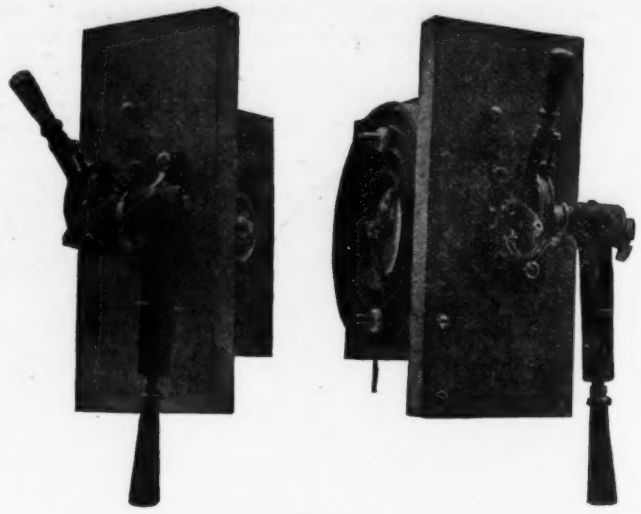


FIG. 2 AND 3.

auditorium. The middle bank for control of the blue lights has dimmers for five border circuits, proscenium arch and footlights, and two circuits for bunch lights. The lower bank controlling the red lights also has dimmers for five border circuits, proscenium arch and footlights. The two dimmers for bunch lights on the middle bank are also arranged for interlocking on the lower bank. This permits the bunch lights to be operated either with or against any other lights.

To the left is shown a gang shaft connected by pairs of mitre gears to the three interlocking shafts. These mitre gears are so arranged as to throw either one of any pair into action, or throw it out entirely.

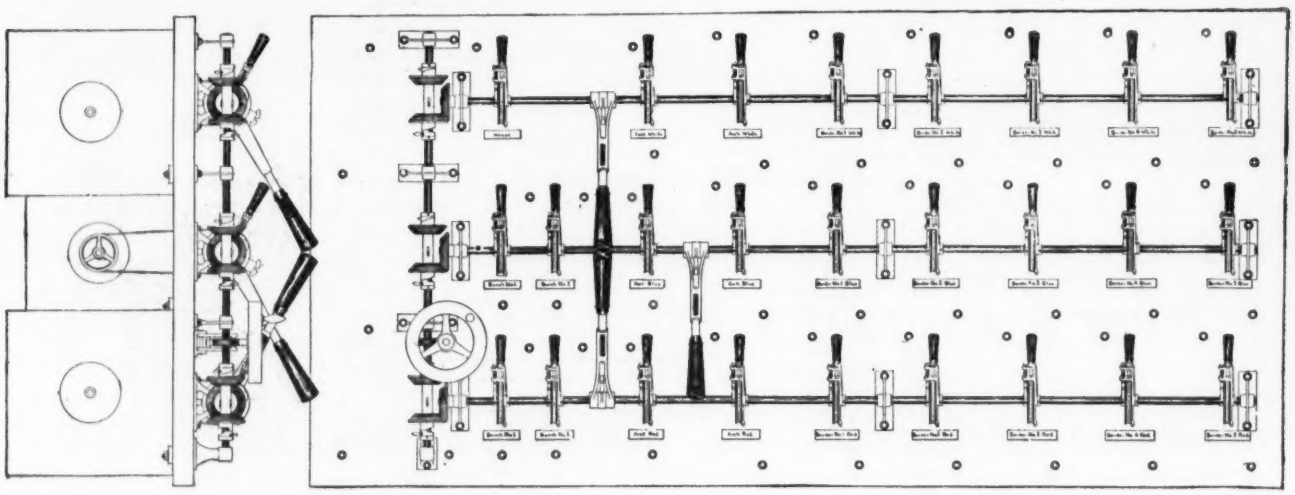


FIG. 1.

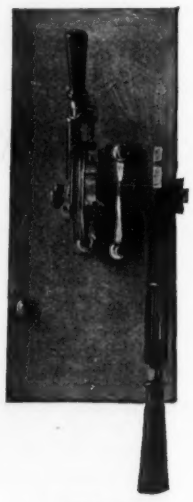


FIG. 4.

The advantages will be best understood by referring to the illustrations. Three views of a single unit are given, one showing the dimmer on the back of the board and the interlocking mechanism, together with the master lever, and a portion of the interlocking shaft on the front of the board.

The loose sheave on the interlocking shaft carries a short lever and handle, and is connected to the smaller sheave on the dimmer shaft by means of a flexible cable. This enables the dimmer to be operated, independently of the rest, by its own lever.

This permits of operating any or all of the three interlocking shafts, and in any combination of directions. They may be run in the same or in opposite direction, as preferred. The gang shaft is supplied also with a worm gear for slow motion, which may be thrown out when desired. Each interlocking shaft has its own master lever, and one of these levers may operate its own shaft, or any of the others. The master levers, being provided with interlocking attachments, may be thrown flat against the board when not in use, and when desired will pick up the interlocking shaft at any position.

The dimmers are all mounted back of the dimmer board, each dimmer independent of the rest, thereby enabling it to be readily removed in case of injury. Provision is made for taking up any slack that may occur in the flexible steel cables when new, and other cables are readily substituted, should it be necessary to change the position of any dimmer.

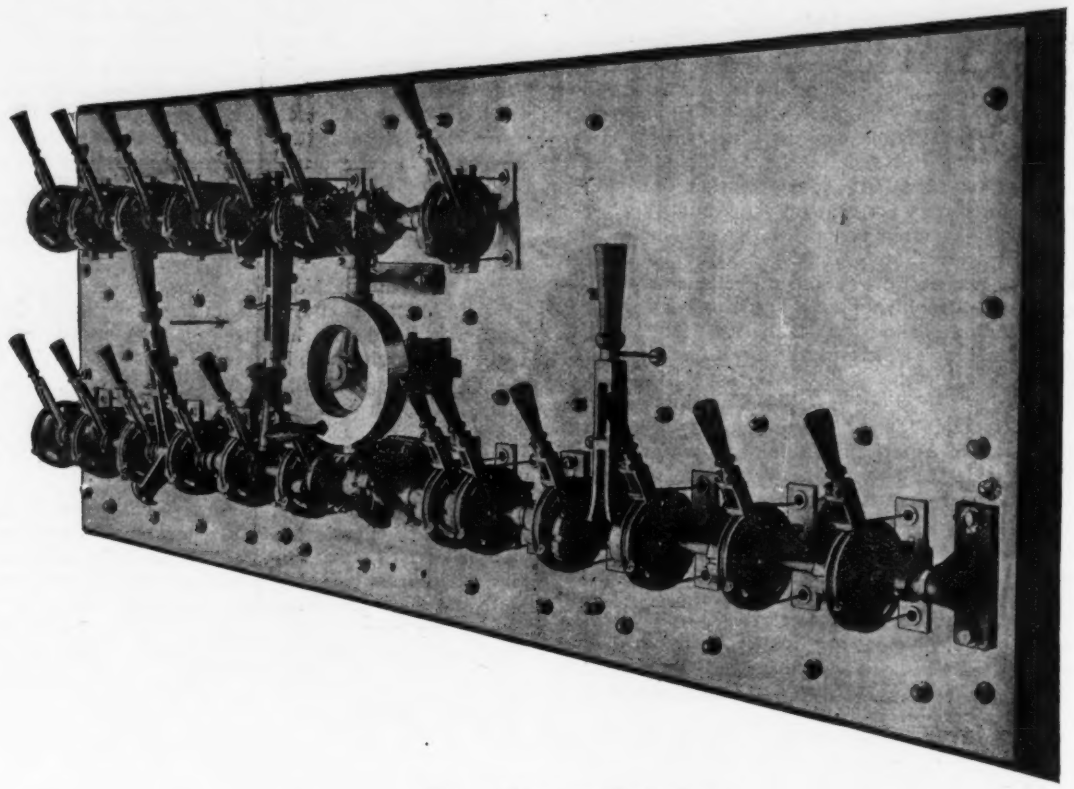


FIG. 5.—THEATRE DIMMER.

The resistance ribbon lies flat against the radiating plates, the only substance intervening being a thin sheet of insulating mica. This construction permits the heat to be most readily conducted to the external surface and thence dissipated. The result is that the resistance material always runs comparatively cool, a condition which best fortifies it against injury in case of an accidental overload.

The method of distributing the heat by means of tapering the resistance and grading the steps enables each plate to work at its greatest efficiency, and therefore permits a heavier load for the size of plate than is possible under any other condition.

The resistance itself, tapered from one end to the other, gives the greatest capacity where the current demands it, and offers, besides, steps of low resistance when the lamps are high and steps of high resistance when the lamps are dim. This produces a dimming effect equal to that which would ordinarily be gained by having 150 or 200 steps.

The switch contacts differ from the usual construction. It is customary to furnish a series of round buttons uniform in size. In the case of these dimmers the contacts are rectangular blocks varying in size, as stated above, according to the ampere capacity desired. This insures cool running contacts, and, together with the laminated switch, good wearing qualities.

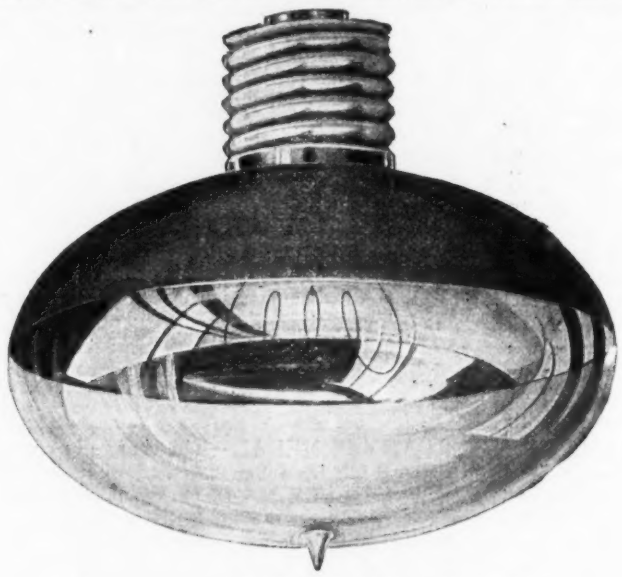
A New Edison Reflector Lamp.

Much interest is taken in the possibility of a high-efficiency incandescent lamp consuming 2½ watts per candle or less. While such a lamp is at present impossible in the regular type, the General Electric Company, by specializing the form of filament and lamp and by the use of a reflector concentrating the light in one given direction, has produced a lamp which increases the efficiency of the incandescent lamp to less than 1½ watts per candle per unit of light on the basis of the illumination in a useful direction.

This lamp is known as the reflector lamp. The filament is made in a four-coil spiral, so as to give the maximum amount of light from the tip end of the lamp. The umbrella type of bulb, with a reflecting surface behind, secures a three-fold concentration of light in the given direction. The lamps are backed with a special reflecting composition, giving a highly-polished, mirror-reflecting effect. The composition is durable and not affected by the heat of the lamp. This backing is furnished with an outside coating of Indian red enamel, green enamel, copper bronze, gold bronze or aluminum bronze, to suit any style of decoration desired. The lower half of the lamp can be furnished either plain or frosted.

The plain, silvered lamp is best adapted to decorative lighting in show windows, and in ceiling and frieze lighting. For desk lighting, however, and reading purposes, the frosted lamp is to be preferred.

These reflector lamps are economical for conditions where a maximum amount of light is wanted in one direction, and they are particularly adaptable for use in theatre, hotel, frieze, window and other forms of decorative lighting. A decided improvement has been effected in the case of the arc light by the use of a reflecting shade concentrating the light in a useful downward direction. In the same way, the reflector lamp secures great improvement in economy, by saving the light which would otherwise be wasted in an upward and useless direction, concentrating it downward. The lamps are made in two sizes, 28 candle-power consuming 36 watts, and 36 candle-power consuming 50 watts, and can be furnished of any voltage or base desired.



REFLECTOR LAMP.

NEWS OF THE WEEK.

Financial Intelligence.

THE WEEK IN WALL STREET.—The stock market was irregular, the disturbance of the European markets by the Chinese situation, and the political situation at home, creating conservatism on the part of large speculative interests. Industrial stocks are quiet, steel stocks being steady at slight improvements. In the money market, time money was easy, being freely offered at 3 per cent on short and 3½@4 per cent for four to six months' arrangements, the demand being only moderate. Call money is plentiful at 1½@1¾ per cent. The results of the trading in electric, electric railway and miscellaneous electric securities are shown below. Brooklyn Rapid Transit closed at 53¼, a net loss of 2⅛ points, the sales being 159,448 shares. General Electric made a net gain of 1⅞ points, closing at 130⅞. Metropolitan Street Railway gained 1 point on the week's business, closing at 151, and Western Union's closing quotation was 79¾, a net loss of 1. In the inactive list of stocks the following are the closing quotations: American District Tel., 25; American Cable, 92¼; Commercial Cable, 160. In list of outside securities there were some substantial advances, particularly in the industrials, which showed the largest gains. The closing quotations of outside electric securities are: Elec. Boat, com., 16; do. pfd., 30; Elec. Vehicle, com., 19; do. pfd., 40; Gen. Carriage, 6½; Ills. Trans., 1⅜; New Eng. Trans., 4¼; New York Elec. Veh. Trans., 6¼; Telep., Telegraph & Cable Co. of Am., 4½. The closing quotations in Boston are as follows: Erie Telephone, 96; New Eng. Telephone, 119; Boston Elec. Light, 169; Westinghouse, com., 44¾; do. pfd., 62; Mexican Tel., 2; American Telephone, 145. In Philadelphia, Elec. Stor. Bat. closed at 75; do. pfd., 80; Gen. Elec. Automobile, ¼.

CENTRAL UNION TELEPHONE.—The Chicago *Economist* says that $500,000 Central Union Telephone consolidated mortgage 5 per cent bonds will be issued this summer, and an additional $500,000 will be put out next fall. This $1,000,000 will cover the construction work for the year, as compared with $1,913,465 spent in construction last year. The consolidated mortgage provides for a total issue of $6,000,000, of which $2,500,000 were reserved to retire the first mortgage 6s, and $2,000,000 were issued up to Dec. 31 last. After the proposed $1,000,000 issue of 1900, there will, therefore, remain $500,000 for further extensions. Up to July 1 the company added about 6000 subscribers, and it is probable that by the end of the year the total number of subscribers will have risen to 75,000, or more than double the number at the end of 1897. There is still a good deal of competition and rate-cutting by independent or non-Bell companies, and this competition will, no doubt, continue until the fittest has survived. There seems no prospect of dividends on Central Union stock until this contest has been fought out.

BOSTON ELEVATED.—The Massachusetts Board of Railroad Commissioners has granted the petition of the Boston Elevated Railway Company for the additional issue of capital stock to the amount of $9,500,000, the proceeds of said stock to be applied only as follows: $3,100,000 shall be applied to construction and equipment of the elevated structure of the railway including foundations, tracks and electric system; $1,200,000 to payment of equipment of terminal and other stations exclusive of lands; $50,000 for equipment of subway; $1,100,000 for equipment of power houses, exclusive of lands; $600,000 for rolling stock and equipment of same; $300,000 for engineering and miscellaneous expenses incurred during the construction of railway; $3,150,000 for real estate and to the payment of damages occasioned by the construction of the railway, including the amount of the second deposit of $200,000 required to be made to the treasurer of the commonwealth.

RAILWAYS COMPANY GENERAL.—The change in control of Railways Company General has been consummated. The new interests which go into the board are: Evans R. Dick, banker, president; Richard H. Rushton, vice-president of Fourth Street National Bank; J. Ogden Hoffman, Philadelphia, representative of the Carnegie Steel Company; Jay Cooke, 3d, of C. D. Barney & Co., bankers, and John J. Collier, secretary of the Investment Company, all of Philadelphia. The company receives about $300,000 new cash capital, $200,000 of which will be applied to liquidate the entire floating debt and $100,000 to retire underlying bonds. There will be no additional issue of stock or bonds. In the treasury of the company there are now $1,325,000 first mortgage bonds of companies controlled and $800,000 stock. There is less than $1,500,000 Railways Company General stock outstanding.

LONG ISLAND LIGHTING PROPERTIES.—The sale of the Long Island Edison Electric Illuminating Company and the Jamaica Electric Light Company to the New York & Queens Gas & Electric Company by the Electric Company of America has been announced. With the purchase of these companies the control of the entire electric lighting and the heat and gas supplies of the Borough of Queens passes into the hands of the New York & Queens Gas & Electric Company. The Edison Electric Illuminating Company, of Long Island, is capitalized at $500,000, having bonds of a similar amount. The Jamaica concern has bonds issued to the amount of $100,000, and is capitalized at $200,000. The payment of over $1,000,000 on the properties has already been made.

SIEMENS & HALSKE REAL ESTATE.—A special despatch of July 16 from Chicago says: "The Siemens & Halske Electric Company has sold to Robert McAllister Lloyd and Walter H. Johnson, of New York City, six blocks at the northwest corner of West Sixteenth Street and Robinson Avenue, in the township of Cicero. The consideration in the deed, which was filed yesterday, was $200,000, and the date was March 31. The property conveyed is 641 ft. by 1883 ft., together with the buildings and fixtures thereon. The sale does not include the electric or other cranes situated on the premises, nor the machinery and tools at hand suitable for making apparatus." The gentlemen named are prominent in Electric Vehicle and allied interests.

TELEPHONE MORTGAGE.—The Central Union Telephone Company, of Illinois, has filed a mortgage for $1,000,000 with the Recorder of Deeds of Sangamon County, in favor of the Old Colony Trust Company of Massachusetts. The telephone company, having acquired more property, franchises, etc., since Jan. 1, 1899, desires to secure the same, and has arranged for a bond issue of $2,500,000, in addition to an issue of $6,000,000 made in January, 1899.

G. E. AUTOMOBILE.—The patents of the General Electric Automobile Company were sold at public auction in Philadelphia last week to satisfy creditors' claims. They were purchased for $29,000 by James W. Cunningham, of 41 Wall Street, New York City. The price at which G. E. Automobile patents sold at auction, $29,000, does not cover the indebtedness, which amounted to $50,000.

THE NATIONAL TELEPHONE & TELEGRAPH COMPANY, with a capital of $50,000,000, as noted in these columns last week, has not yet divulged its plans, but it is said to be intended in some way as a successor to the Telephone, Telegraph & Cable Company, with a wider scope and larger powers.

THE TELEPHONE STOCKS are selling on nearly an equal income basis. American Telephone & Telegraph Company at 145 nets the investor 5.17 per cent; Erie Telephone Company at 98 nets 5.10 per cent, and New England Telephone at 120 nets 5 per cent.

DETROIT EDISON.—The Edison Illuminating Company, of Detroit, Mich., has increased its capital stock from $750,000 to $900,000.

Commercial Intelligence.

THE WEEK IN TRADE.—A check in the downward movement in prices of commodities is shown in the reports from trade centres, and the conditions indicate a revival of business activity. By the publication of the July government crop report the worst has apparently become known as to the situation in wheat, and unquestionable improvement since July 1 has led to the belief that the crop-damage talk, as usual, has been exaggerated. On the whole, the Western crop situation contains many encouraging features. The cotton crop has undoubtedly suffered and condition is unprecedently low for this season of the year, but the acreage planted was a large one, and prices are so much higher that a satisfactory financial return is confidently looked for. In addition, railroad earnings point to the maintenance of the business of the country at a volume in excess of last year. In summarizing the trade conditions, Bradstreet's says that while trade is still of only midsummer volume, the beginnings of improvement in demand are becoming visible. Another wholesale cutting of quotations in iron and steel took place during the week, notwithstanding the effort of the big steel and iron concerns to control prices, if such efforts were really made. The business failures last week numbered 221, as compared with 174 the same week a year ago; 238 in 1898, 247 in 1897, and 255 in 1896. Copper closed at 16.50 for Lake ingot, and lead 4.00.

EXPORTS OF ELECTRICAL MATERIAL.—The following were the exports of electrical material from the port of New York for the week ended July 14: Antwerp—2 cases electrical material, $324; 28 packages electrical material, $2,252. Alexandria—14 cases electrical material, $1,200. British East Indies—34 packages electrical material, $2,643. Bristol—66 electric cables, $10,007. Brazil—4 packages trolley appliances, $211; 5 cases electrical goods, $158. Bari—3 cases electrical machinery, $1,060. Brussels—7 boxes electrical material, $91. British possession in Africa—15 cases electrical material,

$894. Bordeaux—14 packages electrical machinery, $808. Cuba—167 cases electrical material, $25,792. Central America—22 packages electrical material, $521. Glasgow—2 cases electrical machinery, $436; 10 packages electrical material, $402; 1 case motor material, $40; 15 trolley poles, $750. Genoa—19 trolley poles, $1,100. Hamburg—12 packages electrical machinery, $1,043; 83 packages electrical material, $5,443. Hull—1 package electrical material, $38. Havre—50 packages electrical material, $4,801; 18 packages automobiles, $2,550. Japan—67 packages electrical material $3,601; 20 reels cable, $6,398. Leith—9 cases electrical material, $250. Liverpool—1199 cases electrical machinery, $7,265; 3 cases electrical material, $29. London—97 cases electrical machinery, $9,413; 72 packages electrical material, $5,855; 51 cases automobiles, $18,000. Mexico—17 packages electrical material, $485; 1 reel cable, $200. Marseilles—51 packages electrical material, $2,000. Milan—2 packages electrical material, $296. Newfoundland—8 packages electrical material, $143. Nova Scotia—11 packages electrical material, $118; 46 packages motor machinery, $6,200. Naples—175 packages electrical material, $35,115. Odessa—7 packages electrical material, $980. Philippines—33 cases electrical material, $1,895. Porto Rico—79 packages electrical material, $2,686. Peru—3 cases electrical material, $202. St. Petersburg—17 cases electrical material, $661. Stockholm—1 case electrical material, $225. Siam—21 cases electrical material, $1,235. Southampton—14 cases electrical machinery, $349; 12 cases electrical machinery, $379. U. S. Colombia—6 packages electrical material, $152.

ELECTRIC POWER IN MEXICO.—The work of constructing one of the most extensive power-producing plants in Mexico is now in progress in the State of Chihuahua. The plant is located on the San Juan branch of the Concho River. The company was organized several months ago under the laws of Illinois, the principal promoter of the enterprise being R. M. Burke, of Chicago, former United States consul at Chihuahua. It has a capital stock of $1,000,000 gold. The enterprise embraces the construction of a dam in the San Juan River between the cities of Parral and Chihuahua. The dam will be 250 ft wide and 150 ft. high, and will form a lake 15 miles long and 3½ miles wide. The electric power thus generated by the waters from this lake will be transmitted by cable to the city of Chihuahua, 80 miles distant, and to Parral, 40 miles distant. M. B. Place, of Chihuahua, who is largely interested in the enterprise, said in an interview concerning it: "The building of this electric and water-power plant is probably the great undertaking in Northern Mexico. For many years the lack of fuel and high cost of same have retarded the development of the mineral resources around the cities of Chihuahua and Parral, and the company hopes to overcome this condition of things. The system is to be so arranged that connecting cables can be run from the main line in any direction, and whatever amount of power may be desired can be delivered at reasonable cost. In the cities of Chihuahua and Parral from 6000 to 10,000 horse-power have been contracted for. The man who conceived the idea of harnessing the water power at Duluth passed upon the Chihuahua proposition, reporting upon it favorably."

THE KELLOGG SWITCHBOARD & CONSTRUCTION COMPANY, of Chicago, is building for the Cuyahoga Telephone Company, of Cleveland, eight additional sections for its exchange which, when installed this month, will give a total capacity of 9600 lines, and for the time being it will be the largest independent exchange in the country. Mr. Franz Dommerque, of the Kellogg Company's engineering department, who was in Cleveland recently, stated that his company is now at work on more equipments for large exchanges than at any time in its history. The Baltimore exchange is now practically completed, with an equipment of 6000 instruments, and eventually it will have 14,400 lines. The main exchange at Pittsburg is being equipped to its ultimate capacity of 5400 lines, and six exchanges of 3000 lines each are being installed. At Columbus, 2000 lines of the new exchange have been cut in, and the present equipment is 4080. The ultimate equipment is 6000. At Scranton, Pa., the present equipment is 2400, and this will be increased to 6000 by Sept. 1. The Wilkesbarre, Pa., exchange is being increased from 1200 to 1800. A large amount of work is also being done for the Kinloch Long-Distance Telephone Company, which is building toll lines to all towns within 60 miles of St. Louis, with connections with the surrounding States. The small exchanges of this company are being equipped with the Kellogg Company's new universal boards. For the Cuyahoga Company, the Chicago concern is also building a number of private branch exchange boards, and a number of these will be installed in Cleveland in the near future.

ELECTRICAL SUPPLIES IN BOMBAY.—Mr. F. T. Fee, U. S. Consul at Bombay, India, says: The Bombay Tramway, an American company with head office in New York City, some time since applied to the municipality for the privilege of converting its power into electricity. This has not as yet been granted. The municipal commissioner, W. L. Harvey, has declared his intention of giving the city electric lighting, and the matter is now open for bids and offers. Three or four local firms have tendered bids. These firms, I understand, are simply representatives of European capitalists and electric construction companies. I might further say that India possesses an inexhaustible supply of coal, and, while it is inferior to the Welsh coal, yet it is correspondingly cheaper and considered very good for steam purposes. It sells at this port for from 13 to 16 rupees ($4.25 to $5.25) per ton, according to the quality. The cost of transportation of electric supplies and apparatus from our shipping ports to Bombay could be greatly lessened by freighting in sailing vessels around the Cape. This would also avoid Suez Canal tolls, and, by judicious management in shipping, the extra time taken would not be felt. Under the Indian tariff code, a large proportion of an electric plant would enter duty free. However, the question of tariff would not figure in competition for the contract, as all companies are treated equally.

COMMERCIAL JAPAN.—The May number of the *Japan-American and Greater-Japan Commercial Journal* contains an editorial on the commercial progress of Japan. "Everywhere," the article says, there has been unparalleled progress; the tide of industry and art may be considered to have changed the whole material aspect of the country, and what fifty years ago was regarded as the wildest dream of imagination has in our own day come to be looked upon as the matter of every-day life. * * * Our arts and industries have since advanced by leaps and bounds." The advance made in metallurgy, electricity, chemistry and in all other sciences, has reached and benefited trade and commerce in all their manifold ramifications. In Japan there are nearly one thousand members of the American Commercial Association, while in the United States—according to our contemporary—there are only about five hundred. Speaking of the industrial situation in Japan, the Japan *Times* says that the cost of living in that country is fully twice as great now as it was twenty-five years ago, and the price of labor has risen in almost equal ratio. Women, for example, who could hardly hope for anything better than domestic service, receiving as wages little more than food and clothes, can now earn from 30 to 50 sen per day as factory hands, telegraph or telephone operators.

APPARATUS FOR KOREA.—The Westinghouse Electric & Manufacturing Company has a contract for the supply of the electric equipment required for an extension of the operations of the Seoul Electric Company. The contract, which was secured through Frazar & Co., of 63 Wall Street, New York City, is valued at $21,000. The plant will consist of two alternating-current, two-phase belted generators of 120-kw each; three 62½-kw and two 37½-kw static transformers, also one 75-kw rotary transformer, a number of converters for incandescent lights, switchboard and all accessories, etc. The Manhattan General Construction Company, of New York City, will furnish several arc lamps. The equipment will be utilized both for a railway and general lighting work in the Korean city. The Westinghouse people have also received an order from V. A. Kajevnikoff, chief mechanical engineer of the Chinese Eastern Railroad. One 30-kw, direct-connected generator and a 22½-kw machine of the same description have been requisitioned. These equipmeuts are intended for lighting purposes in the Harbin machine shops of the road.

TROLLEYS AT VALENCIA, SPAIN.—Mr. H. L. Washington, U. S. Consul at Valencia, Spain, reports that the negotiations for the transfer of the lines mentioned to the Thomson-Houston Company on a 40-year lease have been brought to a successful issue. The lessees are to substitute electricity for horse traction, to deposit as guaranty about $108,000 in French bonds, to pay a yearly rental of about $23,000 while receipts are below 800,000 pesetas, about $100,000. When receipts reach this figure, the lessors are to receive 5 per cent more, and when they reach 1,000,000 pesetas, 10 per cent. The whole electric plant is to be the property of the lessors, who are also to possess the right to devote to public lighting any surplus electricity generated. Electric machinery and plant, as at present arranged, will be supplied by the General Electric Company, but the cars will be constructed in Spain, where a few factories recently established turn out fairly good and cheap work, though in elegance, solidity and comfort the cars are not equal to the American product.

AMERICAN BELL TELEPHONE.—The American Bell Telephone Company reports for the month ended June 20 as follows:

	1900.	1899.	Increase.
Gross output	55,613	61,399	5,786
Returned	25,671	15,668	10,003
Net output	29,942	45,731	* 15,789
From Dec 21 to June 20—			
Gross output	346,146	341,026	5,120
Returned	132,660	91,737	40,923
Net output	213,486	249,289	* 35,803
Total outs'd June 20.	1,893,878	1,374,175	519,703

*Decrease.

MINERAL INDUSTRY.—The *Engineering and Mining Journal* of June 9 published tables of mineral and metal production of the

United States during 1899. The total value of the output was $1,211,361,861, the total net value being $1,118,780,830, the increase over 1898 being 39.9 per cent. This enormous increase was in part due to an increase in quantities, and in part to the great advance in values of iron, steel, copper and other metals. The United States last year was the greatest producer of coal, salt, iron, copper, silver and lead in the world, and was also a leader in the production of many of the less important metals. The extent of our production is shown by the figures, which include 252,115,387 short tons of coal, 13,400,735 long tons of pig iron, 581,319,091 pounds of copper, 217,085 tons of lead, 129,675 tons of zinc, 57,126,834 ounces of silver and $70,096,021 in gold. The most important single item of production was coal, which furnished 25.4 per cent of the total value. Iron was second, forming 20.9 per cent; copper third, with 8.3 per cent.

COPPER EXPORTS.—Shipments of copper to Europe continue to be enormous. Exports for June, reported by the New York Metal Exchange, were much heavier than for any month in recent years, with the exception of March of this year. There was shipped from the ports of New York, Batimore and Philadelphia during June 11,442 tons, 3301 tons and 230 tons of copper, respectively, and 617 tons of matte from New York, making a total of 15,312 tons of 2240 lbs. Total exports, exclusive of Southern ports, since Jan. 1 this year, 85,035 tons, against 51,723 tons for the same period last year. This enormous export business, however, has not influenced the market to any great extent, as almost if not all of it was shipped in filling former contracts. Mining companies, as is well known, have been sold ahead for some time. Lake copper early in June was quoted at 16½c., but under the apathy of the market has receded to 16¼c.

THE MEXICAN GOVERNMENT has approved the plans for the construction of a plant for the utilization of the waters of the river Lerma, in the States of Michoacan and Jalisco, for motive power. The concession for this enterprise was obtained a few months ago by Mrs. Carmen del Moral. She is permitted to utilize 15,000 litres of water per second from the river, and to construct the necessary electric power plant, dam, etc. Thomas Carter, an American electrical engineer, who has been in Mexico for several years, has been investigating the chances for establishing an electric light and power plant in the city of Guanajuato, Mexico. He represents a syndicate of American capitalists who are willing to invest in such an enterprise if Mr. Carter's report is favorable. Guanajuato is a city of about 50,000 population, and is of considerable commercial importance.

EQUIPMENT FOR THE NEW HALL OF RECORDS.—John R. Thomas, 160 Broadway, New York, has just issued specifications for the electrical, steam and elevator equipments for the new Hall of Records, now being built in New York City. The specifications call for five water-tube boilers, a feed-water heater, 10 duplex pumps, ventilating and exhaust fans, etc., all of the fans to be direct connected to electric motors. The heating will be controlled automatically by thermostats. The steam power equipment will consist of two 240-hp non-condensing Corliss engines, and one 160-hp, all three being direct-connected to dynamos, the two former engines driving 150-kw machines and the latter driving a 100-kw dynamo. There will also be one automatic 80-hp cut-off, high-speed engine.

IMPORTS AND EXPORTS OF COPPER.—For the 11 months ending with May, 1900, the imports of copper were 78,400,124 pounds, valued at $11,423,009, as compared with 42,171,073 pounds, valued at $4,326,151, for the same time in 1899. Exports of foreign copper were 3,785,849 pounds, valued at $556,513, as compared with 1,517,933 pounds, valued at $76,868. Exports of domestic copper were 298,216,233 pounds, valued at $50,014,789, as compared with 241,447,587 pounds, valued at $32,183,555 in the 11 months ending with May, 1899. There was a falling off in the exports of copper to Great Britain, but a large increase in the exports to countries on the continent.

OUR FOREIGN COMMERCE.—The exports of merchandise from the United States during the fiscal year ending June 30 aggregated in value $1,394,479,214, which exceeded by $167,455,912 those of the preceding fiscal year, and establishes a new record in exports. The value of the foreign commerce of the United States for the first time has passed the two-billion mark, the aggregate for the year just closed being $2,244,193,543, or $320,021,742 in excess of that of the previous twelve months. The balance of trade in favor of the United States in that period was $544,764,885, an increase of $14,890,072, compared with the previous year.

JAPAN RAILWAYS.—Private advices from Japan state that the long-projected railroad from Nagoya to Seto will soon be an accomplished fact, and that it has been virtually decided that the motive power will be electricity. The capital of the enterprise, which has been furnished by the Japanese, has been increased from 250,000 yen to 400,000 yen—equivalent to about $200,000 American money. Specifications, the advices go on to say, are about to be prepared, and the electric equipment of the road will, it is estimated, mean an expenditure of about $80,000. Everything in this line will be purchased in the United States.

THE AMES IRON WORKS, of New York City, have been awarded contracts for the shipment of four 100-hp high-speed engines, with boilers, to Bagnall & Hilles, of Singapore. The machinery will be utilized in various electric light plants in the East Indies. The Ames people have also recently secured French orders for four engines and boilers, varying from 75 horse-power to 100 horse-power each. They are to be shipped for electric light purposes to the Société Parisienne des Blanchisseries et Chauffages Economiques, 200 Avenue du Maine, Paris.

LOZIER AUTOMOBILES.—Plans have been prepared by A. C. Rice, consulting engineer, of Worcester, Mass., and contracts on the the same have been awarded, for building a power house and concrete dam on the Saranac River, near Plattsburg, N. Y., for the Lozier Motor Company, which is building shops at Plattsburg to employ 1000 men, and is moving its automobile works from Toledo, Ohio. These shops will be modern in every respect, and the machinery will be driven by current from the power station about three miles away.

THE WESTON ELECTRICAL INSTRUMENT COMPANY, Newark, N. J., will install a large number of individual motors in the new factory which it is erecting. The entire equipment will be supplied by the Sprague Electric Company, and will consist of about 30 slow-speed motors from 5-hp up. In general, each motor will run three or more machines from a small jack shaft, as the nature of this company's work is not such as to require large machine tools.

THE BULLOCK ELECTRIC MANUFACTURING COMPANY, of Cincinnati, has received an order for a 125-hp motor (belt type) from the Norfolk Navy Yard. The same company has an order from the American Thread Company, at Holyoke, Mass., for a 100-kw belt-driven generator, and from the Dayton Electric Light Company, at Dayton, Ohio, for three series arc-light generators of 150 kilowatts each.

PITTSBURG, PA.—Improvements that it is understood will cost in the neighborhood of $200,000 have been outlined by W. K. Schoepf, general manager of the Consolidated Traction Company, for the immediate betterment of the service of the road. Contracts have been awarded for the new switchboard to the Westinghouse Electric & Manufacturing Company and for the feed wires to the American Electrical Works, of Providence, R. I.

NEVADA AND CALIFORNIA.—The Gould and Curry, Sierra Nevada and C. & C. mining companies, on the Comstock Lode in Nevada, have closed contracts for motors, etc., for operating their mills, with the Westinghouse Electric & Manufacturing Company. The Best & Belcher, Yellow Jacket and Union Consolidated companies have closed similar contracts with the General Electric Company.

ELECTRIC LOCOMOTIVE.—The Carnegie Steel Company, of Pittsburg, Pa., has contracted with the Westinghouse Electric & Manufacturing Company for a Baldwin-Westinghouse electric locomotive, which is to be used for hauling purposes in the yards of the Carrie furnaces. The locomotive will weigh 45 tons, have eight wheels, and will be operated at very low speed.

THE BULLOCK ELECTRIC COMPANY, of Cincinnati, has received orders from V. A. Kajevnikoff, chief engineer of the mechanical department of the Chinese Eastern Railroad, for the supply of two 25-kw generators, and also six sets of 15-kw each. These equipments, which are valued at nearly $10,000, are intended for station lighting on the great Manchurian road.

WATER POWER DEVELOPMENT IN WISCONSIN.—The Black River Falls Company, West Superior, Wis., contemplates the establishment of a water-power plant to develop 5000 horse-power at Black River Falls. The estimated cost of the improvement is about $250,000. William Burgess, 24 Third Avenue, Duluth, Minn., is manager of the company.

THE TRUCKEE RIVER GENERAL ELECTRIC COMPANY recently received three carloads of hydraulic machinery for the plant in Floriston, Cal. McCormick water wheels are included in the shipment. The electric machinery, aggregating 1000 horse-power in capacity, has been shipped, and the plant will be in operation early in August.

PURCHASES FOR AUSTRALIA.—Mr. Oliver, a Government Commissioner from Sydney, Australia, who was mentioned in this department recently as being in this city obtaining bids for the machinery and supplies for an electrical plant to cost $1,000,000, is making his headquarters at the offices of R. W. Cameron & Co., 23 South William Street.

TYPEWRITING TELEGRAPH.—It is stated that a company will be formed in this country to take over the patent rights of the Typewriting Telegraph Corporation of London, and exploit the system in this country. Similar companies are to be organized in France, Germany, Italy and other European countries.

Special Correspondence.

ENGLISH NOTES.

London Office, ELECTRICAL WORLD AND ENGINEER,
July 2, 1900.

THE SOCIETY OF ARTS ALBERT MEDAL for the present year has, with the approval of the Prince of Wales, been awarded to Mr. Henry Wilde, F.R.S., "for the discovery and practical demonstration of the indefinite increase of the magnetic and electric forces from quantities indefinitely small." This principle is the one on which the invention of the modern dynamo machine is based, and is employed in all modern dynamos.

THE WESTINGHOUSE BRAKE COMPANY, LIMITED, has just brought out two little interesting brochures, in one of which it gives an interesting illustration of the Newell electric brake which, in addition to acting upon the wheels, acts directly on the track. It also illustrates electric heating devices for operating in conjunction with the brakes and gives some interesting diagrams and details how the cars should be wired for such a combination. The other brochure relates to the "Westinghouse Electro-Pneumatic System for Controlling Railway and other Motors," and illustrates this system for the first time. It illustrates how the device can be used on one or more cars either for single-motor car arrangements, multiple-unit arrangements, or double-motor car arrangements. It is out of the province of this little notice to describe how such a system is used, but it is worth attention of all tramway and railway engineers to make a careful study of this proposition. Both the books are illustrated in the well-known Westinghouse style and show in phantom fashion the details of the apparatus as applied to regular railway practice.

THE BRITISH WESTINGHOUSE ELECTRIC TRACTION COMPANY, LIMITED, of London, has, during the Tramways Exhibition at the Agricultural Hall, Islington, issued a very neat little brochure, entitled "The Westinghouse Exhibit." It has been extremely tastefully designed, and is well illustrated, commencing with an illustration of the electric railway from Cairo to the Pyramids, with an excellent view of the Pyramids in the background. They also give a handsome panoramic view of the town of Rouen, France, with a Westinghouse car shown climbing the hills in the foreground. The Westinghouse gas engine is also illustrated, as is also its conduit system and the new Westinghouse electromagnetic brake. The little book is extremely interesting and gives a very fair idea of what the British Westinghouse is doing on this side and a most excellent idea of what it showed at the exhibition. It has also recently issued another handsome booklet, entitled "Some British Electric Tramways," in which it illustrates in detail most of the apparatus necessary for tramway installations and in which it also shows views of a number of cities in which the Westinghouse system has been adopted. Both books are well worth procuring and will be found to be of great interest to the tramway engineer.

MUNICIPAL ELECTRICAL ASSOCIATION.—The members of the Municipal Electrical Association, who have been attending the fifth annual convention at Huddersfield this week, visited Leeds and discussed several papers at the Albert Hall in that city. Mr. L. Andrews, borough electrical engineer to the Hastings Corporation, read the first paper, which treated of the distribution of electricity in scattered areas and the question of alternating currents versus continuous. Mr. Andrews contended that what suited one town was not the best for another, and to compare the merits of the two systems it was necessary to consider the capital outlay, annual cost of upkeep and the comparative reliability of each system. He also stated that up to the present, continuous currents had been the most reliable, but, with the introduction of necessary improvements, he thought that the alternating system would become as reliable and would cost less. Mr. G. Wilkinson, borough engineer of Harrogate, also read a paper on the same subject, and stated that it was in the distribution from the generating station to the consumer's premises that the greatest risks of failure occurred. He made a plea also for more uniformity of design and standardization in joint-box services, terminal boxes and their accessories. Mr. C. H. Wordingham, city electrical engineer of Manchester, read a paper on "The Maintenance of Certain Portions of Distributing Systems at Earth Potential," with special reference to the system adopted so largely in America, and, in fact, in nearly all tramway systems of connecting one portion of the system to the rails and earth. He made a plea for the simplicity and reliability of the overhead system of traction, stating that it was worth while to go to great lengths to retain the system; but that if it were proved that serious damage was caused to underground structures in urban districts it would be necessary to reconsider the whole decision. In referring to the ordinary three-wire system for lighting, he was in favor of earthing the neutral or middle conductor. Mr. A. E. Le Rossignal, corporation tramways engineer, Newcastle-on-Tyne, submitted an interesting paper giving his impression of American tramway practice, pointing out that it was essentially different from the conditions prevailing in this country. He referred to the difficulty in procuring rights in England and the necessity also for procuring free way leaves and in some cases ground rights as well; and stated that the difficulties of procuring these were infinitely greater than in the United States, where most of the tramways were in the hands of private enterprises. Overhead work in America did not compare at all with what was put up in this country, either in strength or neatness, but he conceded that there was much to be learned from America in that they had realized the great part electric traction played in making adequate provision for transportation and for enabling poor people to live at a greater distance from their work and necessarily in better surroundings than was otherwise the case. Mr. R. C. Quin, electrical and tramway engineer of Blackpool, contributed the last paper which dealt with the protection of telegraph and telephone wires, which is of special importance at present in view of the number of traction systems now being installed throughout the kingdom. The best method of protection appeared to the author to be the placing of the wires underground, where they crossed the line of tramway routes. He believed the telephone company was not averse to this course being adopted, but it was met with the absolute refusal of the post office to consider any such proposition. Under these circumstances, it must recognize the existence of crossing overhead wires, and there he suggested the erection of two guard wires, 18 ins. apart, at a minimum height of 2 ft. above the trolley line.

General News.

THE TELEPHONE.

SALEM, OHIO.—The Columbiana County Telephone Company has increased its capital stock from $200,000 to $300,000.

KALAMAZOO, MICH.—The recent cyclone here caused $25,000 damage to the lines of the Michigan Telephone Company.

MOORESVILLE, IND.—The Mooresville Telephone Company has extended its line to Waverly, and an exchange office opened at that place.

WAUSAU, WIS.—The Marathon County Telephone Company has been organized at Wausau to build an independent line through the county.

WESTERN UNION.—The directors have elected Thomas T. Eckert, president; Charles A. Tinker, vice-president, and Thomas F. Clark, secretary.

GLENCOE, ORE., has been connected by telephone with Hillsboro. The Oregon Telephone Company will further extend the line two miles westward to Harrison.

CUERO, TEX.—The Cuero & Sasseville Telephone Company has been formed. Capital, $6,000. Incorporators: Mrs. Jane Hunter, Mrs. Willie Breeden, Mrs. S. D. Weldon, all of Cuero.

HAGERSTOWN, IND.—The Hagerstown Telephone Company has been capitalized at $6,000. The local plant will be completed by Aug. 1, after which rural extensions will be made.

GREENVILLE, N. C.—The Greenville Telephone Company has passed into the hands of the Carolina & Virginia Telephone Company. A larger switchboard and other improvements will be added.

SAN FRANCISCO, CAL.—The People's Mutual Telephone Company, San Francisco, now has men at work wiring houses, which will be connected with the new telephone system when it is completed.

FORT WAYNE, IND.—The Central Union Telephone Company has made a tentative offer of $100,000 for an extended franchise to take the place of the limited franchise offered by the City Council.

PEKIN, ILL.—The Secretary of State has authorized the incorporation of the Pekin Telephone Company, with a capital stock of $10,000. The incorporators are James W. Barrett, John C. Mead and William A. Potts.

MASON CITY, IA.—The Greene & Western Telephone Company will build 200 miles of line in Iowa and Minnesota. It now has 800 miles of toll lines and 475 subscribers. The company uses the system of the American Electric Telephone Company.

COLUMBIA, S. C.—The South Carolina Telephone Company will soon begin serving subscribers at Columbia. The company will begin with 200 patrons. The Bell Telephone Company is also expending several thousand dollars in increasing its plant in Columbia.

PRINCETON, N. J.—The Automatic Exchange Company, of Princeton, N. J., has been formed to operate telephone lines. Capital, $3,000. Incorporators: H. W. Green, of Trenton; W. Libbey, Mary E. Libbey, both of Princeton; H. W. Green, attorney, Trenton.

CHARLOTTE, N. C.—A movement is on foot among the independent telephone men of the Piedmont section of the Carolinas to consolidate the interests of their present lines. A meeting has been held at Charlotte, N. C., but no definite action has yet been agreed upon.

LOCKPORT, N. Y.—After a long fight, the Common Council has granted the Rawson Electric Company a franchise for a telephone exchange in Lockport. The new company cannot charge for telephones to exceed $3 per month for business places and $1.33 for private houses.

PITTSBURG, PA.—The West Pennsylvania Long Distance Telephone Company has been formed to construct and operate telephone lines. Capital, $10,000. Incorporators: H. A. Parr, S. N. Browne, both of Baltimore, Md.; W. D. Evans, R. A. Spring, W. W. Handy, all of Pittsburg.

COLUMBIA CITY, IND.—A meeting of telephone men representing various towns in northern Indiana has just been held in this city. The meeting was devoted to a discussion of telephone matters and to fix a rate schedule for toll lines, so that charges would be more uniform.

BROCKVILLE, ONT.—The town of Brockville, Ont., has made an offer to the Brockville Light & Power Company to purchase the plant of the company for $85,000. The company has accepted, and a by-law authorizing the raising of money by debentures to make the purchase will be submitted to the ratepayers.

ST. LOUIS, MO.—The employees of the construction, equipment and maintenance departments of the Bell Telephone Company have been granted an eight-hour workday. The new order came voluntarily from the company and went into effect July 10. The same salaries are allowed under the new time scale as under the old.

ADA, MINN.—The Norman County Telephone Company has been formed to conduct a telephone exchange. Capital, $5,000. Incorporators: S. J. Froshaug, of Twin Valley; O. S. Dalby, of Ullman; N. O. Disted, of Perley; A. L. Hansen, J. C. Norby, both of Ada; A. L. Eckern, C. L. Sulerud, both of Halsted; A. M. Eckmann, W. D. Bangs, A. M. Anderson, all of Hendrum.

AKRON, OHIO.—The People's Telephone Company, which has recently opened its exchange, is gaining a remarkable foothold among local business people. Last week the physicians of the city met and unanimously decided to use the telephones of the new company exclusively. The following day the druggists made a similar move, and it was decided that all Bell instruments should be withdrawn from drug stores on Aug. 1. The local grocers' association has called a meeting to discuss the telephone question, and it is stated that they will also decide to use the new independent telephones. The new company now has service in every town and village in Summit County, and has in the neighborhood of 2000 subscribers. Two lines are now in operation between Cleveland and Akron and three more are being put up.

ELECTRIC LIGHT AND POWER.

PHILADELPHIA, PA.—The International Light, Heat & Power Company of Philadelphia, capital, $500,000, has been incorporated at Wilmington, Del.

WILMINGTON, N. C.—The Wilmington Gas Light Company will issue $125,000 bonds for the improvement of its gas and electric plants.

SMITHFIELD, N. C.—The new Smithfield Cotton Mills will be equipped with an electric light system. D. J. Rose, Rocky Mount, N. C., is contractor for the building.

NEW PHILADELPHIA, OHIO.—Mr. E. S. Souers and other local business men are considering putting in an electric lighting plant for business houses and residences at Irondale, Ohio.

ST. LOUIS, MO.—The board of public improvements has been asked to prepare an ordinance to appropriate $30,000 for the erection of a municipal lighting plant to light the city hall, four courts, court house and old city hall.

AUSTIN, TEX.—The city of Austin, Tex., is putting in a steam electric light plant to replace the plant destroyed in the flood of the Colorado River a few months ago. The new plant will be ready for operation in a few weeks.

THE CATARACT POWER COMPANY, of Hamilton, Ont., has installed two new generators in its power house at Decew Falls. By the additional power thus provided, the company will furnish the city with 6000 horse-power.

STEUBENVILLE, OHIO.—Mr. Thomas McConville, of this place, is at the head of a company which has secured an electric lighting franchise at New Kingston, Pa. The company is to be incorporated with a capital stock of $75,000.

KISWICK, CAL.—The Kiswick Electric Light Company has been formed to generate, transmit and sell electricity. Capital, $50,000. Incorporators: H. D. Scribner, A. F. Johns, P. S. Coke, H. C. Donnels, W. H. Bone, all of San Francisco.

BALTIMORE, MD.—Directors of the United Electric Light & Power Company have elected Mr. Pierre O. Keilholtz, who has been general manager of the company since its formation, consulting engineer. Mr. John W. Ellard was elected general manager.

PENN YAN, N. Y.—The Yates Electric Light & Power Company has been incorporated in Penn Yan with a capital stock of $300,000. The purpose of the company is to supply light and power to the village of Penn Yan and Jerusalem, the towns of Benton and Milo.

ALLIANCE, OHIO.—The City Council has passed a resolution for the erection of an electric lighting plant for public and private lighting purposes. The option held by Philadelphia capitalists on the plant of the Alliance Gas & Electric Company has expired, and the company is now anxious to lease or sell its property to the city.

ORILLIA, ONT.—The town of Orillia has reached an agreement whereby R. H. Patriarche, of the Electrical Maintenance & Construction Company, of Toronto, and Mr. Peter Ryan undertake to complete the town's power scheme, by which electric power is to be transmitted from the Severn River, 19 miles distant, to Orillia by the first of October next.

MARSHFIELD, ORE., will have a municipal electric lighting plant of ample capacity for public and commercial lighting. The town has been in darkness since last February, owing to the failure of the local electric lighting company to reduce rates below $11 per arc light per month. The plant, for which negotiations are in progress, will cost $10,000.

LIMA, OHIO.—Buffalo capitalists, who recently bought out the plant of the Lima Electric Light & Power Company, have acquired control of the Lima Railway Company, and the two properties will be operated in conjunction. A number of changes will be made in the system, and it is stated that Mr. Edward Townsend, at present manager of the electric light plant, will be made general manager of the new system.

DETROIT, MICH.—The entire assets, including real estate and plant, of the Detroit Electric Light & Power Company, which have been in the hands of N. G. Williams, as receiver, have been sold by the United States Court, under mortgage foreclosure proceedings for the sum of $165,500. It is understood that the purchaser has made arrangements for the sale of this property to a company composed of the shareholders of the Edison Illuminating Company, of Detroit.

OTTAWA, ONT.—Electric lights and electric fans are being installed on the coaches of the Canada Atlantic Railway. Mr. M. R. Shedd, of the Gould Electric Car Lighting Company, of Depew, N. Y., is in Ottawa, installing the apparatus. The dynamos hang under the car and are driven by belts attached to the axles. Storage batteries are used. The Governor-General's car, "Victoria," has been equipped with the lights and fans.

GRAND FORKS, B. C.—Mr. J. P. Graves has made an offer to purchase from the city of Grand Forks, B. C., the water works and electric light plants at the sum of $70,000 and to expend a further sum of $30,000 in improving the systems. He also seeks to acquire an exclusive street railway franchise. In return for a bonus of $30,000, Mr. Graves offers to provide water works, electric light and trolley systems for the city of Columbia.

NEW BRUNSWICK, N. J.—The Central Electric Light Company, which was recently organized to absorb electric companies in Central New Jersey, has practically completed all preparations for taking over the electric light companies of New Brunswick, Perth Amboy, Rahway, Metuchen and Bound Brook. The Central officers are: President, Philip N. Jackson; vice-president, Adrian Riker; treasurer, Uzal M. Carter; directors, Philip N. Jackson, L. D. H. Gilmour, Dudley Farrand, Uzal M. Carter and Adrian Riker.

SAN FRANCISCO, CAL.—San Francisco again has its streets lighted from sunset to sunrise, after a period of no lights after midnight. Bids have been received from a number of electric and gas companies for lighting streets and public buildings. The contract for lighting a number of the public buildings was recently given to the Independent Electric Light & Power Company, which has its electric system almost ready for operation. The surprisingly low rate of 3 95/100 cents per 1000 watt-hours secured the contract, the San Francisco Gas & Electric Company's bid being 5 cents per kilowatt-hour.

THE ELECTRIC RAILWAY.

CATSKILL, N. Y.—Work has been commenced on the road which will run from Catskill Point through Main Street to Jefferson, a distance of about two miles.

CAMDEN, N. J.—The York County Traction Company has been formed to operate railroads. Capital, $1,500,000. Incorporators: F. R. Hansell, W. F. Eidell, G. H. B. Martin, all of Camden.

JERSEY CITY, N. J.—The York County Traction Company has been formed. principal office, New Jersey Corporation Guarantee & Trust Company, Camden, N. J.; objects, to furnish, light, heat and power; capital, $1,500,000.

NEWBURG, N. Y.—Judge Betts, of Kingston, has appointed William H. Pouch receiver of the Newburg Electric Railway Company. Application was made by holders of third mortgage bonds, through the Hamilton Trust Company, trustees.

MEDFIELD, MASS.—The Medfield & Medway Street Railway Company has held a public opening of its line between Medfield, Medway and Franklin Centre. The new road is four miles in length, and the total length of the system is 20 3-10 miles. The total cost of construction was about $240,000.

CHATTANOOGA, TENN.—A deal has been closed by which the North Side Street Railway Company and Signal Mountain Line pass into control of the Rapid Transit Company of Chattanooga. The purchase price paid for the two lines was $50,000. This will give the Rapid Transit line 38 miles of road in actual operation.

NEW YORK, N. Y.—The New York, Westchester & Connecticut Traction Company will soon begin work on a new trolley road which will, when completed, run from West Farms to Bridgeport, Conn., a distance of 50 miles. The company recently filed a mortgage at White Plains for $2,500,000 to carry out its work of constructing the road.

ELIZABETH, N. J.—The Union County Board of Freeholders has granted to Senator John Kean the right to operate his trolley line between Elizabeth and Cranford after Westfield Avenue has been widened from 60 to 100 ft. The county exacts that Kean pay $73,000 to the property holders whose property will be taken between Elizabeth and Cranford, and demands that he pay the county, in installments, the cost of widening the street. Senator Kean agrees to do this.

LOGANSPORT, IND.—Stockholders of the Logansport, Rochester & Northern Traction Company have elected the following officers: J. T. McNary, president; H. I. Park, Kendallville, first vice-president; Dr. J. B. Shultz, Logansport, second vice-president; G. W. Holman, secretary and general counsel; B. F. Keesling, Logansport, treasurer; Walter Osmer, chief engineer. President McNary says construction will be begun within a month.

WASHINGTON, D. C., will have a horseless and trackless car line. The American Autocarette Company, incorporated a short time ago with a capital of $200,000, will place on the streets a number of vehicles having accommodations for twenty passengers each. They will be run on the storage battery system, with solid rubber tires. For the present a trunk line running the length of the city will be established, but later, intersecting cross-lines will be put in operation. The regular street car fare, 5 cents, will be charged.

THE AUTOMOBILE.

A LIGHT ELECTRIC RUNABOUT.—The Cleveland Machine Screw Company, Cleveland, Ohio, will shortly announce an addition to its line of electric vehicles in the shape of a light, electric runabout. It is stated that the machine will weigh less than 500 lbs.

THE HOUGHTON AUTOMOBILE COMPANY has been formed at East Orange, N. J., to deal in automobiles. Capital, $250,000. Incorporators: G. S. Houghton, W. C. Houghton, H. R. Houghton, A. E. Knowlton, C. V. Childs, G. W. Harrison, W. J. O'Mara.

AUTOMOBILES IN SAN FRANCISCO.—For the first time in the history of the city, San Francisco, this year, had an automobile division in the Fourth of July parade. The display of electric vehicles was quite creditable, although there are comparatively very few "autos" on the coast.

CHICAGO, ILL.—The Baltimore & Ohio automobile service has been extended to include Chicago. The service will be for the accommodation of passengers to and from the Grand Central Station. The vehicles will bear the name of the road and will be offered to the passenger at the rate of 50 cents a mile and 25 cents for every additional mile.

NEWPORT, R. I.—No naphtha or gasolene automobiles will be permitted on the Jamestown ferry. This order has caused grief among the Newport set who visit the pier to "relax," and will cause more annoyance during the two weeks of polo. Should the ferry authorities permit one of this particular kind of automobiles on their boats they could be made to forfeit their license. During polo week an effort will be made to secure a flat barge, which will operate between Narragansett Pier and Newport direct.

NEW YORK CUSTOM HOUSE.—Collector Bidwell has decided to install an automobile service between the Appraisers' Stores and the Custom House. The automobile will take the place of the two cabs which for years have carried the Government's messengers with the invoices up to the Public Stores, in Christopher Street. It is the intention of the department to have the automobile make regular trips, and it is expected that a much quicker service and better results will be obtained. While there have been no complaints from importers regarding any delays at the Public Stores on account of the non-delivery of invoices there, still Collector Bidwell believes in being progressive, and it is mainly to secure prompt delivery that he has decided to try the automobile. Occasionally there has been a slight delay over the appraisal, caused when no invoices were at hand, but it is expected that henceforth there will be no grounds for complaint on this score.

LEGAL.

AUTOMOBILE PATENT.—The Thomson-Houston Electric Company and Edward H. Levis are joint plaintiffs in a suit brought in Cleveland against the Lorain Steel Company, the plaintiffs charging the Lorain Steel Company with manufacturing and selling electrically-propelled vehicles covered by a patent granted to Rudolph M. Hunter. An accounting and injunction are asked for.

RAILWAY MOTOR PATENTS.—The General Electric Company has brought suit in Cleveland against the Lorain Steel Company, charging the latter with conspiring with street railway companies throughout the country to deprive the plaintiff of the benefits of the Knight railway motor patent of October, 1895, of which the General Electric Company is the assignee. An accounting and injunction are asked for.

WESTERN UNION TAXES.—Justice McAdam, in the Supreme Court, New York, has granted a writ of certiorari compelling the State Board of Taxes to review its action in the matter of the assessment levied against the company for this year. The company claims that it has been assessed greatly in excess of the value of the property owned by it. Originally the company was assessed under the franchise tax act on property valued at $580,994. Subsequently the assessment was reduced to $454,546, but even this amount, the company declares, is much too large. According to the figures of the company, its property in this State can only be assessed on $189,191.

OBITUARY.

MR. JULIUS F. PRATT, of Indianapolis, Ind., died recently at Glengariff, Ireland, in the course of a trip abroad for his health. At the time of his death he was vice-president and treasurer of the Atlas Engine Works, of Indianapolis, as well as prominent in many other large enterprises.

PERSONAL.

MR. D. L. LAVENBERG, formerly chief train despatcher for the Wheeling & Lake Erie Railroad, has been appointed chief train despatcher for the Toledo, Fremont & Norwalk Electric Railway.

PROF. ELEAZER DARROW, of Spokane, Wash., was in this city for several days last week inspecting the interesting features of the Westinghouse Electric Works at East Pittsburg. Prof. Darrow is the director of the electrical and mechanical engineering department in the Washington State College.

MR. W. H. LAWRANCE, president of the National Carbon Company, Cleveland, is at present suffering from a most peculiar accident. While playing lawn tennis at the carbon works courts a few days ago, his right arm suddenly dropped helplessly to his side, after tossing a ball into the air. An examination showed that the arm was broken above the elbow.

Trade Notes.

THE LAWTON-BEATTIE COMPANY, of Cincinnati, will install 200 or more telephones in the Gibson House of that city, which is in process of remodeling and enlargement.

THE WYBRO-HENDY COMPANY is installing an electric lighting plant at the Presidio General Hospital, San Francisco. Two 40-kw Bullock generators are direct-connected to two Ohman automatic engines, built in San Francisco. The work is done in compliance with specifications prepared by the government authorities.

THE FORT WAYNE ELECTRIC WORKS, Fort Wayne, Ind., in their "Plant List No. 10," describe a number of installations where the "Wood" apparatus is used. The book is illustrated by views of the various machines, and forms a neat method of placing before station managers the location of working apparatus of this make.

THE ELECTRIC APPLIANCE COMPANY, Chicago, desires to call attention to the fact that the rush for Dayton fan motors is now on and that orders for immediate delivery should be received at once. It reports that regardless of the fact that this is the most successful fan season it has ever had, it is able to ship Dayton fans promptly upon receipt of order.

MACHADO & ROLLER, of 203 Broadway, N. Y., inform us that their business has been turned over as a whole into a corporation of the same name, which will carry it on as heretofore in every particular and at the same address. By means of this incorporation the company obtains increased facilities for carrying on its rapidly-growing business in electrical instruments, etc.

UPRIGHT DRILLING MACHINE.—The Cincinnati Machine Tool Company has issued a handsome 28-page catalogue, devoted to upright drilling machines. Ten machines of this type are illustrated by excellent wood-cuts, which show all the details much better than is possible with half-tone engravings. The latter portion of the catalogue contains a catalogue of drills, chucks and sockets.

THE ELLWOOD IVINS TUBE WORKS, Oak Lane Station, Pa., make a specialty of tubing for electrical purposes, and in almost all metals—soft steel, tool steel, aluminum, brass, copper, etc. Their small aluminum tubing for "pointers" on volt and ammeters is much in demand, owing to its extreme accuracy and lightness. They also make thin lead tubing for covering insulated wires and cables.

POLICE SIGNALS FOR CLEVELAND.—The Cleveland (Ohio) board of control has recommended that a contract be entered into with the Gamewell Fire Alarm Company for a complete patrol alarm system for the city police department. The bid made by the company was $55,350. Bids for a new alarm system and exchange for the fire department have been rejected and will be readvertised for under new specifications.

IMPROVED PRIMARY BATTERY COMPANY.—The business heretofore carried on as the Baines' Improved Primary Battery Company is now conducted under the name of the Improved Primary Battery Company, with offices at 594 Broadway, New York City, at which place all orders for the Baines' improved primary batteries and the Baines' battery grids will be received and promptly executed. Mr. William C. Callmann is manager.

SCREW THREAD TOOLS.—A number of printers' errors occurred in a notice which appeared in this column last week of the new catalogue of the J. M. Carpenter Tap & Die Company, Pawtucket, Mass. Carpenter's Tools appear as "carpenter tools," one of the objects of which is stated to be the cutting of screw "caps." Carpenter's screw thread tools are so well known, however, that these errors probably misled no one.

THE MERCHANTS & MANUFACTURERS' EXHIBITION ASSOCIATION, of Boston, will hold its first triennial show from Oct. 1 to 27. The previous annual shows held by this association have been most successful, and it is expected that the Mechanics' Building, where they are held, will be more crowded than ever. Frank Ferdinand, the president and treasurer, will be glad to communicate with any merchants or manufacturers who may be possible exhibitors.

COLUMBIA INCANDESCENT LAMP COMPANY.—In our issue of June 23 appeared an announcement to the effect that Mr. R. T. Stillwell had been appointed receiver for the Columbia Incandescent Lamp Company, St. Louis, Mo., owing to a ruling of the court that the election of officers held last January was irregular. The receivership terminated June 29, at which date the property and business was restored to the old officers, who are at present the officers of the company.

BOILER AND PIPE COVERING.—H. W. Johns Manufacturing Company's "New Navy Brand" of asbestos fire felt covering has been adopted for the pipe work in the Albany Capitol building. The old covering is to be removed and replaced by this new style material. The contract amounts to over $4,000. This company was also successful in securing the pipe and boiler covering work for the new addition of the Manhattan Hotel, Forty-second Street and Broadway, New York City.

THE SYRACUSE ARC LAMP COMPANY, of Syracuse, N. Y., has recently purchased the entire business and good will of the Toledo Electric Lamp Company, of Toledo, Ohio, and is now filling orders for alternating and direct-current enclosed arc lamps for constant-potential circuits. It is now mailing folders, showing the unique features of the lamp, which is a wide departure in construction and operation. The new company is established in its own factory in Syracuse, where it is turning out lamps, with good prospects of bigger orders in the near future.

THE GARVIN MACHINE COMPANY, New York, in its latest catalogue, has produced a pocketbook of useful information which it is hard to find equaled. The fortunate recipients of this book will find within its handsome red leather binding not only a full description of the many standard tools made by this company, but much useful information regarding mechanical matters. Dimensions, code words and complete "specifications" accompany the excellent cuts which are profusely distributed throughout the volume, and the full index at the back makes reference to a particular machine an easy matter.

AN INTERESTING STORY of young men who have fitted themselves for good positions in architectural, mechanical and electrical engineering work is told in a little book called "Support Yourself While Learning a Profession." Its motto is "to earn more, learn more," and the value of a technical education and the ease with which it may be acquired are illustrated with many examples of young men who have spent their spare time in study and risen from the ranks to important positions in professional life. The book will be sent free on application to The International Correspondence Schools, Scranton, Pa.

KENDRICK & DAVIS, of Lebanon, N. H., have issued a postage-stamp holder in the form of an addressed envelope which is neat and compact. The cover is of celluloid with their name and address on the front and an imitation postage stamp canceled, while the back has the form of an envelope with illustrations of some of their manufactures printed thereon. In the inside of the fac-simile envelope at the front is a calendar for 1900, and in the back is one for 1901 in small size with oil sheets for stamps; and in between is a monthly calendar for 1900. The whole is very tastefully made and, being vest-pocket size, is of such a nature as will cause the users of small motors and medical coils to have a constant reminder of the manufacturers of Kendrick & Davis.

WOOLEY FIRE-ALARM TELEGRAPH.—Several successful tests were made at Columbus, Ohio, last week of a new fire-alarm system invented by L. G. Wooley, of Kenton, Ohio, and which will be placed on the market by the National Magneto Electric Telegraph Company, of Springfield, Ohio. The test was made over the wires of the Central Union Telegraph Company between Columbus and Springfield. Each fire-alarm box has three magnets and a spring mechanism which produces the current without the use of batteries. There is a tester which tests the current every two and one-half minutes to show whether the circuits are in order. If the circuit is broken a bell will ring. Mr. Wooley claims the system will save cities thousands of dollars annually by doing away with batteries. A number of capitalists and experts witnessed the tests, including W. G. Van Brocklin, of New Amsterdam, N. Y., and W. E. Powell, of Johnstown, N. Y.

THE BRUCKNER ELECTRIC COMPANY.—This concern, which has recently been established with general offices in the Electrical Exchange Building, 136 Liberty Street, New York, reports a very satisfactory beginning, having received orders from various sections of the country. Its line of goods, which includes high-grade interior and long-distance telephones, switchboards, etc., is of the highest grade, both electrically and mechanically. Mr. F. C. Bruckner, president of the new concern, states that the new transmitter for central-energy systems, which will be placed upon the market, will be of an improved type, the carbon of which will neither pack nor deteriorate. The company's factory is in the Lexington Building, 141-155 East Twenty-fifth Street, New York (not 125th Street, as previously reported), where the company also maintains a branch office. Mr. Bruckner is well known in the telephone trade and is president of the new company. The new concern will manufacture and install complete interior and long-distance telephones and auxiliary apparatus, and promises to serve all friends and customers in a prompt and faithful manner.

Record of Electrical Patents.

UNITED STATES PATENTS, ISSUED JULY 10, 1900.

[Conducted by William A. Rosenbaum, Patent Attorney, Times Bldg., N. Y.]

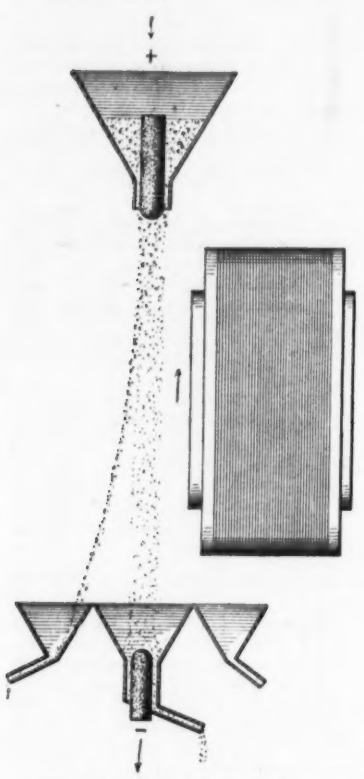
653,218. MOTOR CONTROLLER; D. H. Darrin, Cranford, N. J. App. filed Sept. 2, 1899. With this controller the motor can be stopped at any point short of full speed by breaking the circuit through the manipulation of an extra circuit closer on the handle of the controller and without the necessity of moving the controller handle back to the starting position.

653,221. ELECTRIC TRACTION BALLOON; Marie J. Augustin Deydier, Lyons, France. App. filed Aug. 11, 1898. (See Current News and Notes.)

653,241. ADVERTISING DEVICE; D. W. Hogan, Medford, Mass. App. filed July 28, 1899. This is a balloon to which a transparency is attached which can be rotated to show the various signs on its different sides. The light is furnished by electric lamps.

653,316. TROLLEY; W. H. Russell, Watertown, N. Y. App. filed Nov. 23, 1899. The flanges and tread of the wheel are of hard metal, while the hub, which is not subjected to wear, is of softer metal, the flanges and tread being removable from the hub.

653,319. SUPERVISORY AND BUSY TEST APPLIANCE FOR TELEPHONE LINES; C. E. Scribner, Chicago, Ill. App. filed Oct. 3, 1898. This invention concerns the process of making connection between subscribers' telephone lines and stations of toll-lines or pay stations; and it consists in certain mechanism and circuit connections thereof for assisting in the supervision of the line which is to be united with the toll-line, and in guarding the same against interference pending the establishment of the connection.



653,346.— Magnetic Separation.

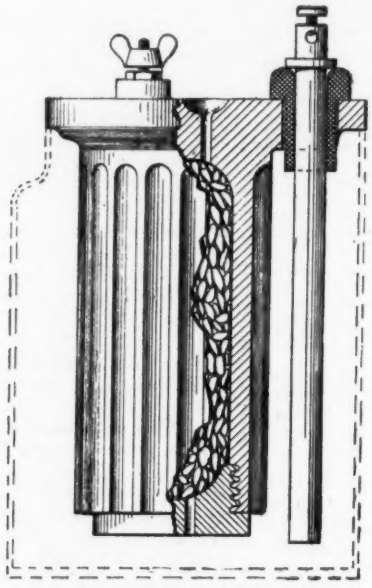
653,342-44-45. DIAMAGNETIC SEPARATION; Elmer Gates, Chevy Chase, Md. Apps filed Sept. 26, Dec. 2, Dec. 2, 1899, respectively. (See Current News and Notes.)

653,346. MAGNETIC SEPARATION; E. Gates, Chevy Chase, Md. App. filed Dec. 2, 1899. This invention relates to the separation of such materials as have very little magnetic susceptibility, such as gold, silver and copper. The invention consists in passing a current of electricity through a falling stream of the granular material, thereby making the mixture itself a conductor for the current, and then allowing the stream to pass through a magnetic field, so that the particles of better conductivity are attracted or repelled by the influence of the magnetic field and caused to move out of the path of trajectory.

653,383. APPARATUS FOR MAKING RADIOGRAPHS; E. Gates, Chevy Chase, Md. App. filed Sept. 26, 1898. With the idea of protecting the sensitive surface from the action of the X-rays until the latter has been developed up to the desired intensity, it is proposed to make a plate holder comprising a removable slide made of a material that is impervious to the X-rays.

653,402. SAFETY TROLLEY; J. W. Richmond, Fishkill-on-the-Hudson, N. Y. App. filed March 28, 1900. Details.

653,422. TELEPHONE TEST SET; A. C. Luddington, Marquette, Mich. App. filed Jan. 18, 1900. A case containing a magneto generator of a peculiar type, a polarized buzzer and a spring jack. These are so connected that for their use only two projecting terminals are required on the exterior of the box.



653,530.—Voltaic Cell.

653,424. SPEED EQUALIZING DEVICE; Alexander D. Lunt, Schenectady, N. Y. App. filed April 30, 1900. (See Current News and Notes.)

653,448. REEL OR SPOOL FOR ELECTRIC THERMOSTATIC CABLES; J. D. Gould, New York, N. Y. App. filed July 10, 1899. Details.

653,459. AUTOMATIC HOTEL CALL BELL; G. B. Reaben, Summit, Miss. App. filed Nov. 1, 1899. Details.

653,468. METHOD OF RENDERING ANTHRACITE COAL CONDUCTIVE; W. J. Burke, Scranton, Pa. App. filed April 27, 1900. The object of this invention is to so treat authracite coal in a retort closed to external air, as to drive off all impurities until practically pure commercial carbon is produced, the article so produced being a good conductor of electricity.

653,469. ELECTRIC SIGNALING APPARATUS; H. G. Carleton (Carleton Electric Company), N. Y. App. filed March 16, 1900. This is a hotel call apparatus designed to enable a guest to send a variety of calls. (See page 106.)

653,470. SELF-STARTER FOR ELECTRIC MOTORS; H. H. Cutler, Chicago, Ill. App. filed June 8, 1899. A plurality of electromagnets are adapted to be successively energized to remove the resistance from circuit step by step.

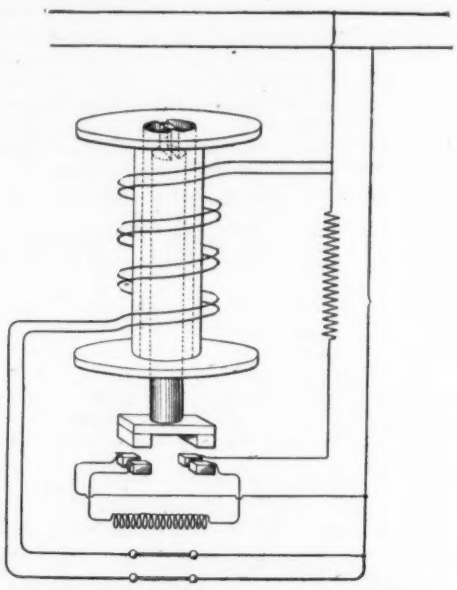
653,471. CONTROLLER FOR DYNAMO ELECTRIC MACHINE; H. H. Cutler, Chicago, Ill. App. filed Aug. 24, 1899. In connection with the means for regulating the voltage of a dynamo, means are provided for checking the rise or fall of voltage beyond certain pre-arranged limits.

653,472. CONTROLLER FOR DYNAMOS OR GENERATORS; H. H. Cutler, Milwaukee, Wis. App. filed Aug. 24, 1899. A modification of the preceding.

653,530. VOLTAIC CELL; C. T. Richmond, Cleveland, Ohio. App filed Oct. 9, 1897. A carbon cup closed above and provided with a flange by which it rests upon the edge of the jar and having a screw-threaded plug closing the bottom.

653,538. ELECTROLYTIC APPARATUS; N. L. Turner, Simon City, Idaho. App. filed June 7, 1899. Details of the devices for supporting the electrodes.

653,549. ELECTRIC TROLLEY; T. Derrick, Lansingburg, N. Y. App. filed Jan. 27, 1900. Details of a ball bearing.



653,554.—Circuit Controller for Incandescent Lamps and Magnetic Guide Therefor.

653,554. CIRCUIT CONTROLLER FOR INCANDESCENT LAMPS AND MAGNETIC GUIDE THEREFOR; M. W. Hanks, Pittsburg, Pa. App. filed April 22, 1899. This invention relates to systems of electric lighting wherein glowers of rare earth are required to be artificially heated until they reach a degree of conductivity which adapts them to serve as illuminants for the lighting system. The invention consists of a solenoid arranged in circuit with the glower and controlling both sides of the circuit which includes the initial heater.

653,572. ELECTRIC ARC LAMP; J. A. Fleming, London, England. App. filed Dec. 23, 1899. A lamp employing two carbons, one of which is provided with two longitudinal passages separated from each other by a carbon wall, and rods of refractory material located in the passages and so arranged that the electric arc will be formed between them and thus heat them to incandescence.

653,585. CONTACT BRUSH; S. L. Neely, Pierron, Ill. App. filed Oct. 23, 1899. A contact brush for railway systems comprising a head including two elements, a number of wires clamped between the elements and elastic plates interposed between the elements and the wire.

653,590. PRIMARY BATTERY; E. R. Post, Newburg, N. Y. App. filed Feb. 5, 1900. Details.

11,840. (Reissue.) CONTACT SYSTEM FOR ELECTRIC RAILWAYS; W. Grunow, Jr., Bridgeport, Conn. App. filed May 29, 1900. This invention covers improvements on prior patent, No. 586,845, and relates particularly to the mounting of an electromagnet which moves bodily when energized to complete the circuit to the working conductor, the current passing through the core of the magnet.